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HEY GROVES

AT a recent meeting, the Editorial Committee found itself with no other course than to accept with much regret the resignation of Hey Groves, who has been Editorial Secretary for the long term of twenty-eight years. A period of ill health aggravated by enemy action is the only reason which has induced our Editor to give up a task he carried out so faithfully. Such an important event in JOURNAL affairs cannot be allowed to take place without record in our pages.

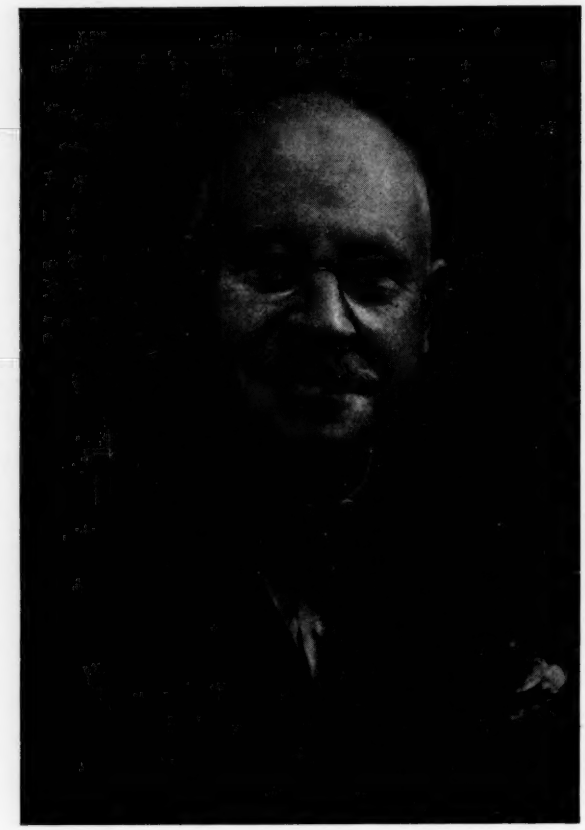
The story of the founding of the JOURNAL was related in the first Moynihan Memorial Lecture, but the outstanding fact which must now be emphasized is that the idea of the JOURNAL originated in Bristol, the home town of Hey Groves, and at a time when his forceful character was making its influence felt in surgery. It appeared to Groves and others with whom he discussed the venture, that success would depend on whether or not widespread interest could be aroused and maintained among British surgeons throughout the Empire. In stimulating that interest and securing co-operation Groves played a great part.

Eventually a large Editorial Committee was appointed, representing a galaxy of surgical talent not only from the British Isles but from all parts of the British Commonwealth. Hey Groves was invited to accept the post of Editorial Secretary and under his direction the preparatory work went steadily on, the first number duly appearing in July of 1913. Since that date four issues have been produced every year and the JOURNAL has increased in stature, importance, and circulation. It was indeed fortunate for us that Moynihan, our first Chairman, and Groves, our Editorial Secretary, worked so admirably together, and that for so long a term of years their collaboration was as effective as it was unruffled.

During all this time the services of our Editor have been remarkable and steadfast and his robust honesty of purpose and tireless work have served the JOURNAL well. A wide knowledge of world literature and foreign travel have given Groves a breadth of outlook which has been of great value. Our present position entitles us to claim that we rank very high among the leading surgical journals of the world, and it is not too much to say that this enviable position is very largely due, not only to the work, but to the outlook and the sustained interest of our first Editor.

The Editorial Committee set out to produce a first-rate surgical journal which should include the best, and as far as may be only the best, in British surgery, and they have never deviated from that ideal. It has been largely the task of the Editor to see to it that this high purpose has been maintained. But it has not all been plain sailing, and Hey Groves could tell of times when material was scarce and he wondered anxiously where the next contributions were to come from; or when, though relatively abundant, the material did not reach the appropriate

standard; but throughout Groves maintained supreme confidence. During the whole of his service our Editor has read every communication that has been submitted and, let it be remarked, this does not mean only the papers that have ultimately been published, but a great many that had to be returned to the authors, either because they were not quite what the JOURNAL required, or the JOURNAL was not the best place for their publication, or the material was not up to the standard we had set ourselves.

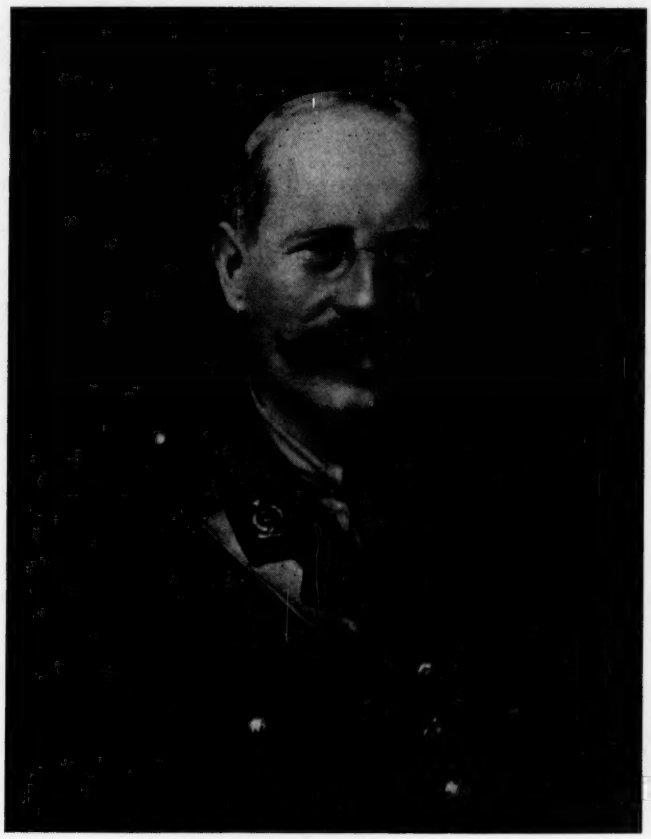


E. W. H. G. to-day

Like all really good editors Groves seemed to have a natural instinct for discovering weak spots and could use the blue pencil with firm assurance. Even in the case of those papers which were readily accepted, there were many occasions when advice had to be given in rearrangement or redrafting and when the choice of illustrations and the manner of their reproduction had to be settled. If anyone scans our series of twenty-eight volumes and realizes that each contains on an average some 700 pages, they will get at least some idea of the laborious work which has had to be faced year in year out by our Editor. But in addition to all this Groves did his fair share of the review work and assisted generally in the management of the JOURNAL which often demanded attention, for much anxious discussion had often to take place between Editor and publishers.

Except for the period when Hey Groves was on foreign service during the last war, he has attended practically every meeting of the Journal Committee and has himself presented the business in apple-pie order so that its consideration proceeded without a hitch.

Most people think of Hey Groves in connexion with bones and joints, but to occupy the position of Editor of our JOURNAL demanded the wider knowledge which he was able to bring to the task, for Groves was a general surgeon of wide training before his later work stamped him as an outstanding orthopædic surgeon.



E. W. H. G. 1916

To edit the JOURNAL might be regarded as a whole-time occupation, but with Groves it has been carried on side by side with other notable activities. He is well known as a surgical author, and, in his capacity of Professor of Surgery in the University of Bristol, as teacher and examiner. For the long period of twenty-three years he has been a member of the Council of the College of Surgeons, where he has held nearly all the important offices and lectureships. That Groves has the confidence and regard of his fellows is witnessed by the fact that he is a past President both of the Association of Surgeons and the British Orthopædic Association.

It will be a pleasure for our readers to know that Hey Groves is now to act as Consulting Editor, to whom we may turn for advice and on whom we can rely for guidance, while Surgeon Rear-Admiral Cecil P. G. Wakeley has assumed the responsibility of the Editorial Secretaryship.

THE FILIGREE OPERATION FOR INGUINAL HERNIA

By PERCIVAL P. COLE
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THE filigree operation for hernia is associated in this country with the name of McGavin and with the Seamen's Hospital (Dreadnought), where he worked and where the tradition has been steadily maintained. The double filigree method for inguinal hernia, to which attention will be confined, was devised in 1905. The method was described and figured in the *British Medical Journal* of August 14, 1909, and was incorporated in an exhaustive contribution made by McGavin to the first edition of Choyce's *System of Surgery*.

I joined the staff of the Seamen's Hospital in 1911, with McGavin as corresponding senior. Since 1921, when McGavin retired, it has fallen to his successors, and perhaps particularly to me, to keep alive the procedure which has been subjected from time to time to much criticism, usually misinformed and frequently prejudiced. An answer to such an attack contained in J. Hutchinson' book, *Hernia and its Radical Cure*, 1923, was made by me in *The Lancet*.[1] At this time the article contributed by Gallie and Le Mesurier to the *British Journal of Surgery*[2] focused attention on the use of fascial grafts in the treatment of hernia. The method quickly became popular and in the eyes of many enthusiasts a golden age had dawned in which hernia in all its forms would cease to vex.

The effect of this publication upon contemporary practice may be judged from a study of the attitude taken up by surgeons, acting as teachers in authoritative text-books, and in the expression of their views in discussions at meetings of medical societies.

The most striking instance was the elimination of the method from Choyce's *System of Surgery* 1932.[3] The original article by McGavin was revised by C. C. Choyce, who, utilizing the first person, stated in reference to the filigree operation, " though still sometimes useful, especially in ventral hernia, this operation has been replaced by Gallie's operation ", and the reader is referred for details of the filigree method to the *British Medical Journal* of 1909. It might well be assumed that this apostasy was attributable to McGavin himself, but he would not have voiced or sanctioned it.

In *Modern Operative Surgery*,[4] the history of hernia and its cure is briefly reviewed in the article on Hernia written by the late H. W. Carson and revised by Grey Turner. But the filigree operation is not considered worthy of mention. In fact, no mention of the operation now survives in representative books on modern surgery, such as those already cited, or in *Rose and Carless's Manual of Surgery*, 1940,[5] *Post-Graduate Surgery*, 1937,[6] Rowlands and Turner's *The Operations of Surgery*, 1936,[7] and such a representative American text-book as Horsley and Bigger's *Operative Surgery*, 1940.[8]

Romanis and Mitchener[9] mention filigrees when dealing with the treatment of direct hernia, but " in place of two overlapping filigrees ", it is stated that " one

large one is usually sufficient." Neither of these statements is relevant to the procedure under consideration.

The attitude taken up towards the use of fascia is by no means uniform, and it has become increasingly clear during the last few years that the claims made for it have not been substantiated. In fact, an inclination has been shown to revert to older methods. For instance, Ogilvie in *Recent Advances in Surgery*, 1928,[10] adopted Gallie's method and urged its merits. In Rowlands and Turner's *Operations of Surgery*, 1936,[7] this same writer referred to " the filigree of silver wire employed with such success by Lawrie McGavin ". Fundamentally, hernia is unchanging; it is what it was. Nor has any improvement in the public health or living conditions brought about diminished incidence. It is by nature and frequency as important as ever, and it follows that a method successfully used to attain its cure must retain absolutely the same measure of success. The only justification for the rejection of such a method is that relatively some other method or methods have been shown to be greatly superior.

The filigree method has been just as successfully employed by others during McGavin's term of office at the Seamen's Hospital, and for nearly twenty years since he retired from practice. Reasons are given for preferring the silk mesh, but admission is made that the two methods are in many ways very similar. Particularly is to be noted the admission that silk is " a foreign substance ".

At a meeting of the Royal Society of Medicine, 1937,[11] Ogilvie again referred to " the use of silver wire or silver lattice as a means of constructing a new defence mechanism in place of the sphincteric one that has failed ". The silver lattice—not ' filigree ', be it noted—was placed in the same category as fascial suture strips or imbrication of aponeurotic layers in " the formation of a strong sheet of tissue to replace the failed inguinal canal ". There could be no clearer presentment of what the filigree operation sets out to do and does.

In *Post-Graduate Surgery*, 1937,[6] this same writer advocated the use of silk lattice repair in preference to fascia, thus reviving a method described by Sampson Handley in June, 1918,[12] and referred to by him as the " darn and stay-lace method ".

The academic solicitude to keep the tissues clean is here frankly abandoned and ' foreign-body ' surgery is promoted to the place of honour, albeit silk is used in place of silver. All that is attempted is reinforcement of the posterior wall. The procedure advocated is mechanically defective compared with the unmentioned filigree operation, the outcome of which is that the inguinal viaduct for other structures than the cord exists no longer, for access to it is denied obliquely from above and directly from behind.

Moreover, the tissues are more tolerant of silver than of silk. In my experience infection compelling removal or causing extrusion of filigree is unknown, and I have failed to trace such an occurrence either by reference or report at the Seamen's Hospital. The same claim cannot be made for silk or fascia by their most ardent advocates.

Lessened Use of Filigrees.—In the course of a discussion on hernia at the Royal Society of Medicine, 1937,[11] Mr. E. T. C. Milligan stated, quite correctly, that the use of filigrees at the Seamen's Hospital had diminished. A reference to the table will show that this occurred during the years 1935–7.

NUMBER OF FILIGREE OPERATIONS AND TOTAL NUMBER OF OPERATIONS FOR INGUINAL HERNIA PERFORMED AT THE SEAMEN'S HOSPITAL FROM 1920 TO JULY, 1940

Year	*Total*	*Filigree Operations*	
1920	95	20	(20 per cent)
1921	130	11	(8·5 per cent)
1922	131	10	(8 per cent)
1923	152	21	(14 per cent)
1924	155	35	(22·4 per cent)
1925	171	33	(19 per cent)
1926	173	35	(20 per cent)
1927	197	63	(32 per cent)
1928	235	81	(34 per cent)
1929	243	75	(31 per cent)
1930	209	55	(26 per cent)
1931	230	59	(25 per cent)
1932	220	56	(25 per cent)
1933	239	71	(30 per cent)
1934	169	58	(34 per cent)
1935	208	30	(14 per cent)
1936	253	20	(8 per cent)
1937	220	24	(11 per cent)
1938	170	39	(24 per cent)
1939	97	36	(36 per cent)
1940 (July)	58	30	(51 per cent)
TOTAL	3755	862	(23 per cent)

It was at the same time emphasized that this was not due to dissatisfaction with the method, but to the belief or hope that fascial suture afforded an even better solution. In this country, the movement in favour of fascial repair was gathering such momentum and the support given was so intense and widespread as to force, even from me, some measure of withdrawal. Living sutures were heralded as the solution to the problem of hernia and by antithesis filigrees were anathematized as 'foreign-body' surgery. An experience of my own will serve as an illustration: A practitioner visiting the Hospital came to the theatre and saw me insert filigrees for the cure of a direct hernia. The operation went particularly well, but instead of the expected congratulation, I was informed that, in his opinion, the operation was so unjustifiable that I might be sued for malpractice! Moreover, the increasing popularity of fascial repair could not be disregarded, so that this method was adopted in a considerable number of cases suitable for filigree implantation. The fascia was inserted by means of a modified Reverdin needle and feeder[13] to overcome the tearing effect of Gallie's needle and to minimize sepsis by reducing handling to a minimum. The relegation of the filigree, however, was not for long, and its restoration to favour occurred during a period when doubts were arising elsewhere as to the real value of the fascial method. The leading article in *The Lancet*, 1937,[14] drew attention to the figures and conclusions on this subject set out in the *Annals of Surgery*[15] by Burdick and his co-workers.

These observers were so dissatisfied with the results obtained that they had practically abandoned the use of fascia. In many re-operated cases, moreover, they had been unable to find any evidence of previously used fascial sutures and therefore had been forced to conclude that the theory of fascial sutures for hernia repair is based on an erroneous principle. Such recent contributions in this country as those of Simpson Smith,[16] Gray,[17] and Wakeley,[18] clearly confirm that fascia has not fulfilled its early promise.

POST-OPERATIVE RECURRENCE

It has never been denied that recurrences occur. Seamen are so nomadic and so frequently derive from foreign countries that anything like a complete follow-up is impossible—and less than that is useless. In 1926[19] an attempt was made to trace fifty cases selected on the basis of probable accessibility. Twenty replies were received, a proportion quite inadequate to be of convincing positive value.

McGavin wrote to me in 1924 stating that from 1907–21 he had only seen two cases of recurrence after filigree implantation, and that both of these had been cured by re-implantation.

Keynes, during a period of eleven years with the Truss Society, was able to instance only one case of recurrence after a filigree implantation in a review of from four to five hundred cases of recurrence taken by him as a text for a contribution to the Royal Society of Medicine.[11]

It is certainly true that recurrence is rarely seen at the Seamen's Hospital, and it may not be without significance that seamen of all grades are frequently sent to the Hospital with nominated reference to me by the Shipping Companies concerned. During a period of ten years from 1930 to 1939, both years inclusive, twelve hernias recurrent after an original filigree operation performed by me or by my official deputy were again admitted under my care. In seven cases recurrence had occurred in two years or less, while in five cases periods of from six to fourteen years had elapsed. All cases were easily dealt with, in the manner described, by the senior resident, my corresponding junior on the staff, or by myself. It may now be permissible to make known that among medical colleagues who have been treated by filigree implantation McGavin himself was one.

Recurrence occurs at one site only, and one mechanism alone is involved. In every case the protrusion has occurred to the medial side of the deep filigree, pushing aside in an upward and outward direction the whole consolidated canal as its size increases. The relation to the cord has been established after this structure has emerged from between the two filigrees.

I have not seen or heard of any protrusion, be it extraperitoneal fat or viscus, being found between the superficial and deep filigrees. It follows that the fear of strangulation occurring in this way is purely illusory as an inhibiting incubus. In the early stages recurrence is very easy to remedy, for the sac appears through a well-defined ring at the lower angle of the wound, which is easily closed by the insertion of a small oval-shaped filigree specially made for this purpose.

I was told of a recurrence after the use of filigrees which was dealt with by a well-known surgeon at an E.M.S. Hospital not long ago. He proceeded to remove the filigrees, and I can easily imagine that this self-appointed task did not favourably commend their employment. I maintain that, in the rare event, recurrence is the fault of the operator and not of the operation; that cure should be effected easily; and that the last thing required in this connexion is the misguided attempt to remove the filigrees. Cure can be promised in every case provided that, in the rare event of recurrence, prompt report is made to enable proper action to be taken.

The period elapsing before recurrence is a point on which opinions differ. It is held by authorities in this country that the bulk of recurrences are noted in less than two years and that of these the great majority occur in the first year after operation. Page,[20] however, demurred, and quoted Block's[21] figures, which show

that 34·8 per cent of recurrences are noted after two years. Burdick[15] and others record that 40 per cent of the recurrences noted by them occurred after two years.

To test the position in terms of our own experience, a period of forty months, chosen haphazard, was selected. During this period 26 cases of recurring hernia were admitted. It was noted that in 15 recurrence had occurred in less than two years; in 11 cases two years and over up to twenty years had elapsed from the time of operation to the onset of recurrence, a percentage of 42.

The general trend of opinion is that the oblique hernia is due to the presence of a preformed sac in an otherwise normally constituted canal, and the whole weight of my own clinical experience supports this view. The elimination of the abnormal and determining factor from an otherwise normal canal will restore the individual to a condition in which herniation at that site will be no more likely than in one not the subject of such a congenital defect. Cure in these cases is brought about not because of, but in spite of, unnecessary procedure beyond the essential and adequate removal of the causal intruding factor—the sac. Whatever procedure is adopted, provided that it is not too subversive, will secure the same measure of success in such cases. True recurrence, then, in early cases obliquely, must be due to persistence in some degree of the introducing mechanism—the sac—or to changes brought about in the construction of the canal by the size and duration of the hernia whereby the differentiation in the mechanical factors normally concerned in the production of oblique and direct herniation no longer obtains.

In this connexion, however, it is particularly noteworthy that by far the greater number of so-called recurrences after operation for oblique hernia are direct in form. This observation has been amply confirmed. Page[20] emphasized that recurrences are not properly oblique or into the remains of the original sac, and cited Block,[21] whose figures went to show that the majority of recurrences are internal direct in nature.

Ogilvie[11] went further when he declared that " the great majority of recurrences appear in the form of a direct hernia when an oblique one was formerly recorded ". Gallie and Le Mesurier[2] recorded experience to the same effect. That direct hernias should recur frequently was a recognized fact, " but that hernias which were originally oblique should recur as direct hernias appealed to us as wanting explanation ". In oblique inguinal hernia the cures, they say, are accomplished in all probability quite irrespective of the attempt to close the supposed abdominal defect.

An oblique hernia acts as a safety valve. Operation not followed by oblique recurrence will completely eliminate this safety-valve action, and thereby, in a general way, herniation elsewhere will be rendered more likely. If this general tendency were the operative factor, it would be manifested generally and not by the occurrence of a somewhat surprising phenomenon at one particular site. It is difficult to understand why such an occurrence should be regarded as a recurrence. The lesion truly occurs in the same region, but beyond that the manner of presentation is a testimony to the success of the previous operation and not a manifestation of failure unless it be conceded that operation for the cure of oblique hernia is a factor predisposing to the evolution of a direct hernia. The time factor is important, but an arbitrary limit cannot be set. All that can be postulated is that consequent responsibility will attach in diminishing degree as the time period increases.

In the face of figures such as those recorded by Page,[20] it is difficult to avoid this conclusion. It may reasonably be assumed that of the 20·2 per cent recurrences not more than 5 per cent were true in that there was a repetition of the original oblique hernia. In the case, then, of picked men employed as policemen, and of an average age of only 31 at the time of operation, there was after operation and within a minimum period of ten years an incidence of *direct hernia* to the extent of 15 per cent. There is here, surely, reason enough to attribute direct responsibility for this outcome to whatever operation was performed. The high recurrence rate—17·3 per cent—recorded by Burdick[15] and others in direct primary hernia must compel the same suspicion. In Page's series fascia was not used; in Burdick's fascia was used in all cases. The nature of the operation performed is not specified, but in view of this omission and the widespread popularity of the method, it is likely that procedure of the Bassini type was used. Successful issue after Bassini's operation for oblique hernia is not, I submit, attributable to merit, but to the fact that the reconstruction effected does not depreciate the defensive mechanism in the particular case to an extent sufficient to cause failure.

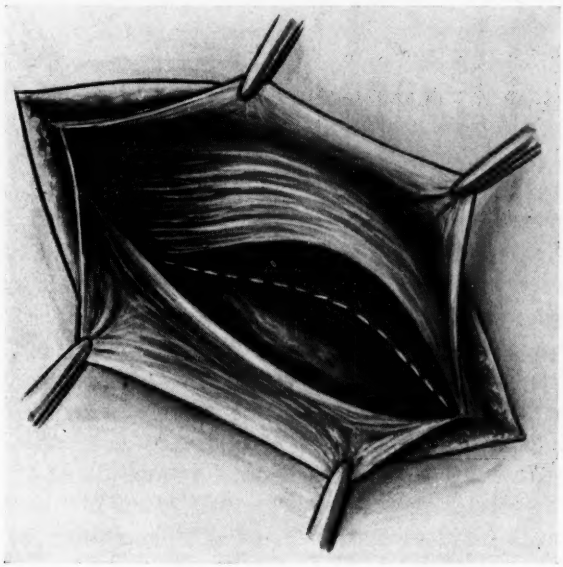


FIG. 146.—Showing the extent to which Poupart's ligament is approached by the arching muscular fibres and conjoined tendon when the muscles are stimulated by the faradic current.

The Bassini type of operation has been adopted when fascia has been used, but apart from this I have not performed a Bassini operation for years. The diagram (*Fig.* 146) shows the extent to which Poupart's ligament is approached by the arching muscular fibres and conjoined tendon when the muscles are stimulated by the faradic current. Owing to the dense attachment of the transversalis fascia to these structures internal to the deep epigastric vessels, this fascia participates in the enveloping action which hugs the cord and its coverings and so converts canal and contents into a solid cylinder, the mechanical resistance of which to breaching effects is obvious. The difference between the resting and active states is illustrated diagrammatically in *Fig.* 147. From this conception two points

emerge: First, that if approximation of any kind to Poupart's ligament is to be undertaken, it should be done in front of the cord with a view to helping and increasing the natural grip; secondly, that with a view to competent participation in this mechanism of resistance, the cord should have a reasonable bulk and that consequently endeavours to thin it out unduly are misapplied.

It is difficult to gauge the failure of any operation when information on essential data is missing: consideration must be given to such factors as operability rate; the classification of oblique hernia into 'recent' and 'long-standing' categories, with or without adequate truss control; and differentiation of the oblique and direct forms.

The long-standing, large oblique hernia has produced changes which range it with the direct as a reconstructive problem. In view of the trend demonstrated in the case of the so-called recurrent hernia, it is particularly relevant to examine the status of the direct variety. Where direct hernias have been separately listed, the recurrence rate has been variously stated as 25 per cent (Page[20]), 11·6 per cent (Fallis[22]), 40–50 per cent (figures cited by Gallie and Le Mesurier[2]), 25·8 per cent (Burdick[15]), 25 per cent by Gracie and Johnson,[23] whose cases, with average age of 56–57 years, were almost certainly direct in fact or in effect. These figures apply to primary cases. It is little wonder that figures for recurrent cases are hard to come by. Burdick,[15] employing fascia, records a recurrence rate for recurrent cases of 40·8 per cent in 154 cases. Wakeley[18] admits to 38·6 per cent in an undifferentiated group. In view of these figures it may safely be assumed that any undifferentiated series with low recurrence rate includes few, if any, direct or recurrent hernias.

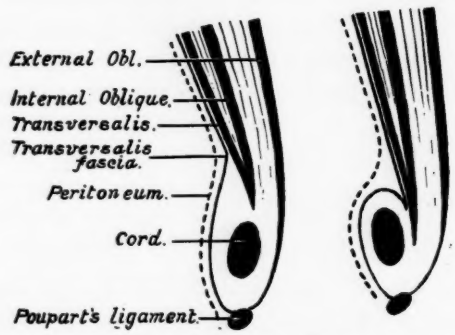


FIG. 147.—Diagram showing the difference between the resting and active states.

Lately, in this country, O'Connor[24] published such a series, claiming 100 per cent of successes. Wakeley[18] traced 851 out of a total of 1140 primary cases, with recurrent rate of 5·4 per cent. No indication is given in his statistical survey of the number of direct hernias dealt with, or of the number of infants, boys, or adolescents included, and the question of operability rate is ignored.

The attitude taken up by this contributor as by others towards direct hernia is vague and tentative. It is, he says, "not so important, because many patients are content to wear a truss". The patient will naturally wear a truss if advised to do so, but contentment will be compelled by the absence of any alternative. For many years now, and increasingly of late, men of all ages with hernia of all kinds and often of long standing have sought treatment by operation at the Seamen's Hospital because otherwise they would be rejected for further service. Whatever may happen in other Services, their predicament would be ill met by advice to wear a truss.

Rose and Carless[5] state that in many cases it is wise to order a double truss, but in some, operation is permissible. Grey Turner (1934)[4] says that attempt to cure direct hernia is of comparatively recent date. Romanis and Mitchener (1934, 1937)[9] state that few cases of direct hernia are really suitable for radical cure. At

the Seamen's Hospital the direct hernia has been accepted for operative treatment without question for over thirty years. That the direct hernia is more than an occasional occurrence in this institution is indicated by the figures for the first six months of the war. During this time, chosen because I was Resident Surgeon in Charge, 63 inguinal hernias were submitted to operation. One man alone was rejected because of chronic bronchitis. No case is rejected on account of the local condition alone and operability rate is 90 per cent at a modest estimate. Of these hernias 35 were oblique and 28 direct. In each group there were 4 recurrent cases. In one of these, recurrence followed a filigree operation and in three—housed curiously at the same time—external oblique aponeurosis had been used to provide a fascial suture and the operation had been performed by the member of the surgical staff who at the Royal Society of Medicine disclaimed all knowledge of recurrences after this operation.

MECHANISM OF DIRECT AND INDIRECT HERNIA

Initially, an oblique hernia is always due to developmental failure—it is in the strict sense never acquired, no matter how depreciated may be the musculature. The hernia that is truly acquired is direct in form, and many factors may contribute to its causation. This dissociation is strikingly demonstrated when there is found, admittedly rarely, a small, thin-walled, virginal sac in the course of an operation on a presenting hernia, obviously direct. If, as is hereby suggested, the operative mechanism is fundamentally different, confirmation may be forthcoming from the study of bilateral cases. The dual mechanism may be coexistent with resultant production of both forms of hernia in the same person. In this case the hypothesis, although not thereby disproved, will derive nothing by way of confirmation. But if the direct and indirect forms do not occur together in a series of bilateral cases, prior to, but checked by, operation, it follows that the incidence of either form is not fortuitous or indiscriminate, but is dependent upon the operation of sharply differentiated mechanisms.

I have used the records of the Seamen's Hospital to obtain information on this question. Fifty consecutive cases have been taken in which the hernias were primary and the condition present was confirmed by operation on both sides. In compiling these, I have rejected one case only. In this there is stated to have been a small indirect sac on one side and a small direct sac on the other. On both sides the operation performed was ligature of the sac and suture of the conjoined tendon in front of the cord. It is probable, I think, that the sac, if direct as stated, must have protruded through a small defect in the transversalis fascia and can thus be rightly disregarded. (Reference to this type of herniation has been made in recent literature. It is much more common than is usually recognized.)

In one case only, and on one side only, was the saddle-bag condition indicated by the records. It should be generally recognized that the larger segment, the direct bulge, is the primary lesion, the smaller portion lying external to the deep epigastric vessels being merely an extension of the process. Subject to these possibly debatable instances, the hernias were of the same type on each side in fifty consecutive bilateral cases.

The problem of hernia, then, is residual. The value of additional procedures must be gauged by ability to make good after the damage inflicted by the long-standing, large, oblique hernia ; to repair the breakdown of the defensive mechanism

manifested by the presence of the direct hernia; and to provide a reliable means of dealing with recurrences.

In these directions a large measure of success is claimed for the filigree operation properly performed, and it is on the basis of this claim that it is presented for judgment. That the issue has not been confused by the use of filigree indiscriminately will be shown by reference to the table previously cited. Reference to the impossibility of a systematic follow-up has already been made. Statistical evidence based on our belief that the sailor returns to his own hospital in case of need will not be readily accepted. It can, however, be said with certainty that in an institution where the types of hernia cited are accepted without regard to the local condition, where operability rate is at least 90 per cent, and where direct hernia contributes such a high percentage of cases dealt with, the filigree operation has stood the test of time and is still an established procedure.

OPERATIVE TECHNIQUE

The Filigrees.—Changes have been made in the construction of the filigrees. The wire used is slightly thicker, 28 S.W.G.; the central stay has been replaced by lateral ones; several sizes have come into use as the result of experience; and the shape of both deep and superficial filigrees has been slightly modified. In

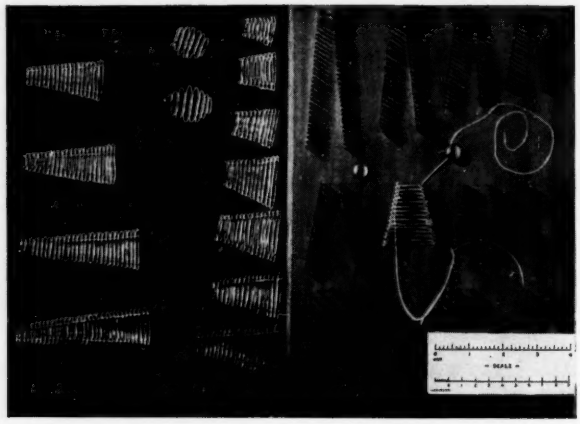


FIG. 148.—Filigrees of various sizes, with the pin-holding board on which they are made.

Fig. 148 are shown finished filigrees in all sizes as now used, together with the pin-holding board on which they are made. One filigree is shown in process of construction, and at the bottom right-hand corner is a scale in centimetres and inches. Stock is replenished as depleted and a complete set is available at every operation.

The Operation.—The incision should be long and situated well above and parallel with Poupart's ligament. The external oblique aponeurosis is incised at a high level to provide an ample lower flap. The cord is dislocated. In the case of the oblique hernia the coverings of the cord must be incised to permit exposure and isolation of the sac. Direct hernia is related to the cord by contiguity rather than by inclusion. In both cases the cord is freed downwards and upwards: downwards to form a loop in the operation area that will give unimpeded access to the whole canal; upwards, to expose the epigastric vessels which in the saddle-bag formation of sac should be divided between ligatures. (*Fig.* 149.)

Treatment of the Sac.—The oblique sac with narrow neck is twisted, transfixed, and cut away. If the communication with the peritoneal cavity is large, the greater part of the sac is cut away and a purse-string suture inserted from the inner aspect of the sac as high as possible. If the sac is scrotal it can be cut across, leaving the lower part untouched.

In the direct hernia the diffuse bulge occurring in spare subjects should merely be pushed back. There is little or no extraperitoneal fat and the fascia transversalis should be left untouched as a buffer between filigree and intestinal contents. Protrusion over a large area may consist entirely of extraperitoneal fat or may have a peritoneal extension of varying size. Where this herniation occurs through a relatively small and well-defined hole in the transversalis fascia the type of hernia is that referred to recently as being rarely met with. I have come to regard it

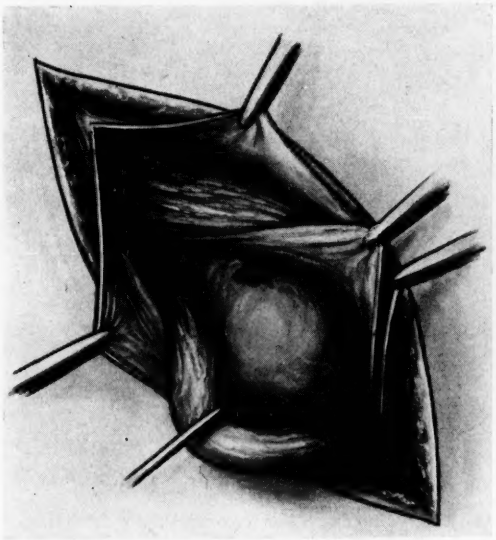


FIG. 149.—The cord freed upwards to expose and ligature the epigastric vessels.

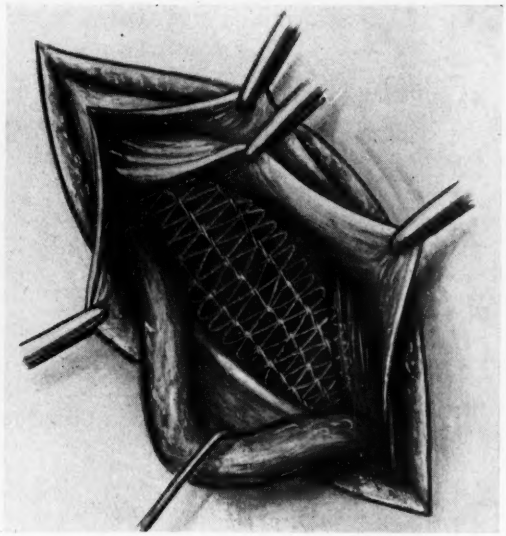


FIG. 150.—A long filigree, used in this case owing to the situation of the protrusion and the ligation of the epigastric vessels.

as quite common, the difference between it and other forms being more a matter of degree than kind. It is always possible to expose extraperitoneal fat by snipping through the thinned-out transversalis fascia as distal to the base of the protrusion as differentiation of structure will allow.

The whole circumference should be freed until complete mobility is attained. Should the shape proclaim the probable presence of a definite sac, the extraperitoneal fat should be stripped off and the sac dealt with *secundum artem.*

Preparation of the Bed.—The bed in this case is made good by utilizing the freed extraperitoneal fat, by suturing together the thinned-out transversalis fascia and, if necessary, by incorporating any odd tissue in the neighbourhood, or by deliberately splitting the overhanging muscle-fibres. (A bed *must* be made to support and define the position of the deep filigree.) Where necessary to allow approximation without too much tension to Poupart's ligament, the arching fibres of the internal oblique and transversalis and the conjoint tendon should be clearly defined.

Finally, in many cases, it is wise to define the outer edge of the rectus at its extreme lower limit to enable a corner of the deep filigree to be tucked under it to safeguard the 'angle of recurrence'. A filigree is selected of a size that will allow it to lie flat in the prepared bed. The operation illustrated was performed on the case sketched in *Fig.* 149. Owing to the disposition of the protrusion and the ligation of the epigastric vessels, the deep filigree is necessarily long (*Fig.* 150). As a rule, the base of the deep filigree extends to, but not beyond, the epigastric vessels, which are not disturbed. The filigree is maintained in position by suturing the overhanging muscle-fibres and tendon to Poupart's ligament behind the cord (*Fig.* 151). Three or four stitches usually suffice, and the lowest may, if convenient, pass through the exposed portion of rectus. It is very rarely thought wise to attach the filigree directly by passing a stitch through a marginal loop. The cord is now

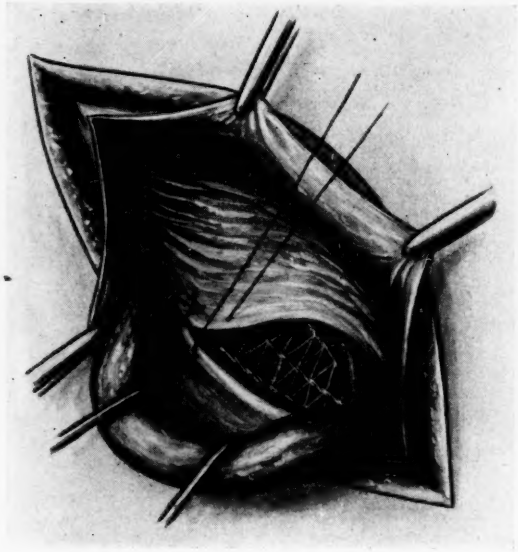


FIG. 151.—The filigree held in position by suturing the overhanging muscle-fibres and tendon to Poupart's ligament behind the cord.

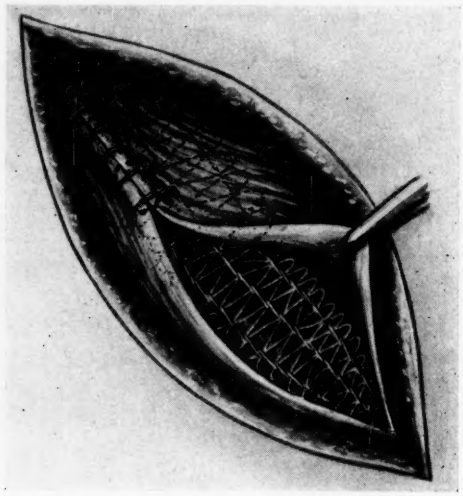
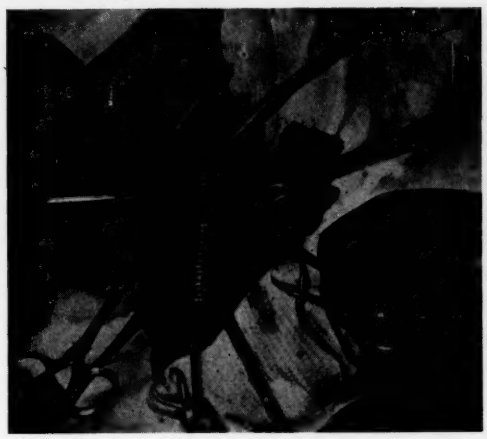
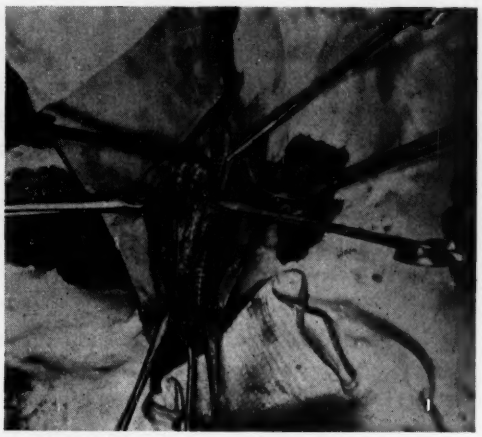


FIG. 152.—The superficial filigree extending well beyond the deep filigree below and approximating in length to that of the incision in the external oblique aponeurosis, which is stitched together over it.

replaced and tucked down into the scrotum so that it lies fair and straight. The superficial filigree should extend well beyond the deep filigree below, and above can extend the whole length, or nearly so, of the incision in the external oblique aponeurosis, which is stitched together over it (*Fig.* 152). The method of procuring approximation with broad area of contact prior to suture is shown in the photographs *Figs.* 153–155. Three or four mattress sutures are used at the site of the controlling pressure forceps and the whole incision is then united by a continuous overstitch. The deep layer of the superficial fascia is brought together by a continuous lockstitch. The skin is united by a continuous overstitch. Catgut is used throughout.

In *bilateral* cases, as has been stressed particularly by Page[20] and Fallis,[22] operation is never performed on the two sides at the same time. A period in bed of at least a fortnight or even three weeks must elapse before the second side is dealt with.





FIGS. 153–155.—Photographs showing the method of procuring approximation with broad area of contact prior to suture.

AFTER-TREATMENT

In a few cases some serous fluid may escape from the upper part of the wound, usually on or about the seventh day. This may be due to imperfect hæmostasis or the existence of a deep dead space in spare subjects with very deficient musculature. All patients, after a filigree operation, are kept in bed for three weeks. They are instructed to exercise care in the movements undertaken and in the grade of work done for three months after their discharge so that return to normal life and strenuous exercise is not allowed until four months have elapsed since the operation.

ANÆSTHESIA

It is a rule rarely departed from, and only for some special reason, that no other form of anæsthetic than spinal is used.

Notes, kindly made by Dr. William W. Mushin, Honorary Anæsthetist, Seamen's, Central London Throat, and Royal Dental Hospitals, on the administration of the spinal anæsthetic, are appended.

From Lawrie McGavin in 1910 to Percival Cole in 1940, the routine method of anæsthesia for this operation at the Seamen's Hospital has been spinal analgesia. Until about 1921, Barker's solution of stovaine (5 per cent stovaine in glucose) was used, but since then Chaput's solution (10 per cent stovaine in saline) has held the field as being more reliable. Recently percaine (1–200 in 6 per cent glucose, i.e., the hyperbaric solution) has been more frequently used, and I now believe it to be the agent of choice. That the anæsthetic technique has remained materially unchanged apart from the agent used, implies that it satisfies both anæsthetic and surgical requirements.

Spinal analgesia is used because :—

1. For this operation the surgeon desires the extreme muscular relaxation which spinal analgesia gives.

2. There must be no straining during the operation.

3. There must be no straining during the immediate post-operative period. Although a patient who has had a low spinal does very occasionally vomit, this is slight compared to the average post-anæsthetic vomiting where a comparable degree of relaxation had been obtained with other methods.

4. It is often of assistance to the surgeon for the patient to be conscious. Even if he is slightly drowsy as a result of premedication, he can cough at request, and supply information if necessary.

5. The majority of the patients at this Hospital are seamen, and are large, muscular, and robust men, in whom the induction and maintenance of inhalation anæsthesia at the required depth would present a problem.

Chaput's Solution of Stovaine (10 per cent stovaine in saline) has been used for so long because :—

1. With proper technique failure is unknown.

2. Analgesia develops rapidly, and the operation may be commenced as soon as the towels are in place.

3. Fixation of the stovaine is rapid, and the volume of solution used is small, so that after 5 minutes tilting the table makes no difference to the level of analgesia.

4. The technique is simple and is easily acquired.

5. The duration of analgesia is from $\frac{3}{4}$ to 1 hour.

6. Nausea or vomiting rarely occurs with subumbilical analgesia. (*N.B.*—Stovaine is considered by many as unsuitable for operations in the upper abdomen because of the difficulty of producing analgesia above the umbilicus.)

7. With correct technique, the incidence of headache and retention of urine is no greater than with other agents, with the possible exception of hyperbaric percaine.

Percaine (1–200 solution in 6 per cent solution) is now used because :—

1. The analgesia lasts at least twice as long as stovaine, and the need for supplementary anæsthesia in robust patients is entirely avoided.

2. More accurate control of the level of analgesia is obtained.

Points in Technique.—

1. *Premedication.*—Adult patients receive omnopon gr. $\frac{1}{3}$ and scopolamine gr. $\frac{1}{150}$, 1 hour before operation.

2. *Administration.*—Strict asepsis is observed. The dose for adults is 0·7 c.c. of Chaput's solution of stovaine. No barbotage is performed, and the solution is injected rapidly. The spinal needle used is a stainless steel Pitkin needle 22 or

20 S.W.G. The skin is not anæsthetized prior to lumbar puncture, but is first pierced, practically painlessly with a sharp straight needle of triangular section and having a glass head. Lumbar puncture is always performed in the lateral position, using the 3rd or 4th lumbar space. After injection the patient is placed on his back with the table level. Analgesia comes on very rapidly and the operation can be started immediately. Ephedrine is not now given as routine. On the rare occasions when a vasopressor is needed during the operation phedracin or coramine is used.

3. *After-treatment.*—Six-inch blocks are placed under the foot of the bed for 6 hours. The patient is then allowed a small pillow only for a further 6 hours, but for 12 hours after the operation is not allowed to lift his head. Drinks are given freely on return to bed, and solids when the patient desires it. No reading is allowed for 24 hours after the operation.

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BONE AND CARTILAGE TRANSPLANTS
THEIR USE AND BEHAVIOUR

By RAINSFORD MOWLEM

It is over forty years since Ollier, McEwen, and others reported successful bone transplants. To account for the survival of these transplants they elaborated theories which were accepted until Leriche and Policarde raised queries as to their validity about fifteen years ago. Since that time other workers have continued in the search for finality as to the fate of these transplanted tissues, but the published results are apparently conflicting.

During the last war the high incidence of extensive facial injuries resulted in the establishment of a specialized branch of surgery for their repair. In this work it became necessary to use bone and cartilage in much more superficial areas than had hitherto been the case. It is therefore possible to observe more accurately by clinical, histological, and radiographic means the behaviour of these transplants. In the beginning cartilage was chiefly used for, say, the restoration of a nasal defect, but subsequent investigation tended to prove that this substance is not altogether ideal, and it has therefore been gradually replaced by iliac bone. Considerable progress has been made in the elaboration of older methods and in the introduction of new ones. This development continues, and two series of cases showing the progress that has resulted are here reported: (1) Forty cases of cartilage transplant; (2) One hundred and fifteen cases of iliac bone transplant.

1. CARTILAGE TRANSPLANTS

The indications were chiefly loss of nasal bridge support, but in addition there have been a few cases where maternal ear cartilage has been utilized as the basis for the reconstruction of a congenital defect of the pinna in a child. With the exception of these latter cases, all the operations in this group were carried out more than six years ago. We might, therefore, subdivide them into two main categories, autografts and homografts, though the behaviour of the two is almost identical.

a. **Cartilaginous Autografts.—**

Operative Technique.—The donor area was most frequently the right seventh costal cartilage. Access was gained either by an incision over the line of the cartilage with division of the overlying rectus fibres, or by a vertical incision splitting the muscle, with subsequent lateral retraction. The whole diameter of the cartilage was freed by a raspatory for a distance of about 2½ in., and the exposed section removed. It was generally necessary to use only part of the removed cartilage for the purposes of the graft, and the remainder was stored in a subcutaneous pocket in the abdominal wall. The graft was inserted by splitting the columella and separating the two layers of the septum as far up as the lower margin of the remnants of the nasal bones. At this point the dissection was continued upwards

in front of the nasal bones by lateral undermining. After the insertion of the graft the columellar wound was closed by two or three stitches. No fixation was necessary, but it was sometimes desirable to provide external pressure by means of a mould of dental modelling compound to control any tendency to oozing in the undermined area.

b. **Cartilaginous Homografts.**—Though the majority of these have been reconstructions of a pinna, there are also a few cases where stored costal cartilage from the abdominal wall of one patient has been utilized as a transplant for the nasal bridge of another.

Operative Technique.—For reconstruction of the pinna the upper two-thirds of the maternal ear cartilage is dissected out from its skin linings under local anæsthesia. The margins of the skin defect are closed and the two layers maintained in approximation by pressure bandaging. The residual defect is less than would be anticipated. The cartilage itself is immediately implanted in its recipient area (*Fig.* 156).

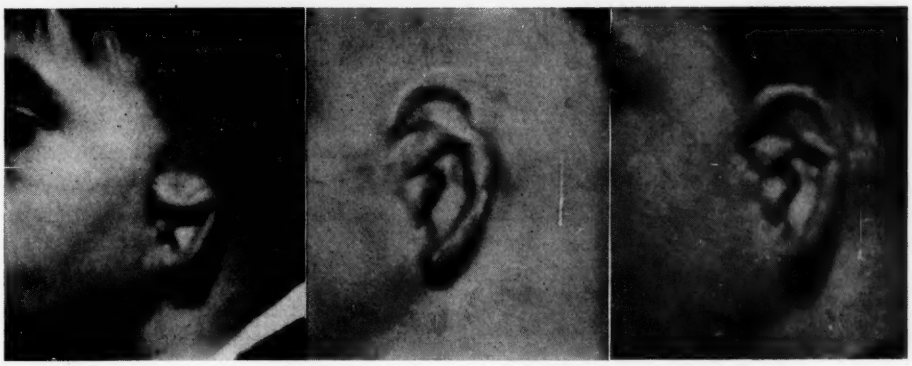


FIG. 156.—Materna cartilage transplant utilized to form the upper half of the pinna in a case of congenital deformity. A, Original condition; B, Showing the outline of the transplant beneath the skin; C, The transplant raised from the scalp by a whole-thickness skin-graft.

The survival of these types of graft is good, and does not appear to depend upon blood grouping. Their subsequent behaviour is clinically indistinguishable from that of an autograft.

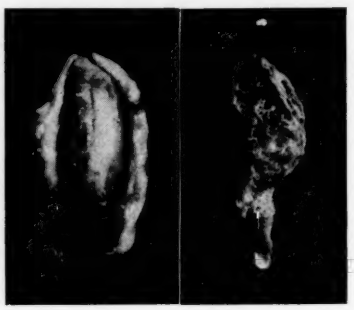
There is a further extension of homografting which has some popularity in America. Recent cadaveric cartilage can be stored in merthiolate to await insertion. Before use it is thoroughly washed in saline. This method has the advantage that it reduces very considerably the magnitude of the operation, but the behaviour of cartilage so treated appears to differ from that of fresh cartilage and will be referred to later.

The Post-operative Behaviour of Cartilage Transplants.—Since it has been found that there is no clinical difference between the autografts and the homografts, both types will be considered together.

a. Wherever cartilage is used there is little evidence of local tissue reaction.

b. Cartilage is a relatively avascular structure and does not undergo absorption even after a period of years. In many cases a graft removed as much as five years after its insertion still bears the original knife markings. It is embedded in a layer

of dense fibrous tissue which replaces its perichondrium and which in some cases invades and pits the surface to a depth of perhaps half a millimetre. This seldom appears to occur over the whole of the graft, but is confined to relatively small areas (*Figs.* 157, 158).



A B

FIG. 157.—Cartilage grafts removed four years after insertion. A, Showing the layer of dense fibrosis surrounding the cartilage—beneath this are seen the original knife marks; B, Showing distortion of the graft and pitting of the surface.

FIG. 158.—Microphotograph of graft shown in *Fig.* 157, B.

c. Microscopical examination shows the cellular structure of the transplant to be relatively normal (*Fig.* 158).

d. The reaction of the transplant to surrounding infection is poor, and even early drainage will seldom save it. If it is not removed it will be extruded either as a whole or in fragments after some months of low-grade sepsis.

e. Occasionally a costal cartilage is encountered which is so spongy in consistency, having almost a trabeculated appearance on section, that it is valueless as a support.

FIG. 159.—Gross distortion of an originally straight graft.

f. A certain proportion of transplants which are apparently perfectly satisfactory upon insertion, become distorted within a few months (*Fig.* 159). Of the 40 cases under consideration 16 showed clinical deviation, and in 10 of these this was sufficiently severe to necessitate secondary trimming. Distortion does not appear to occur in those comparatively rare instances in which the whole thickness of the costal cartilage can be used. Personal communications from Sir Harold Gillies and from Mr. T. P. Kilner lead me to believe that this difficulty was not encountered in the first years of the use of cartilage grafts. The change cannot be due to any alteration in the cartilage itself, and it seems possible that improved technique has resulted in the demanding of a higher standard of perfection than was previously considered satisfactory. In other words, cartilage was being utilized for the correction of conditions for which it was not always well adapted.

In an endeavour to control the tendency to distortion the following methods were evolved :—

i. The first and most obvious solution was to trim the graft in situ if distortion did occur. This was not always satisfactory, as it was found that once the stability of the graft was disturbed, further twisting might occur, though not necessarily in the same direction.

ii. After shaping, cartilage was stored in the abdominal wall for three months. The proportion which underwent distortion remained about the same, and here again secondary correction was not necessarily followed by stability.

iii. In those cases where the nasal bridge line was the recipient area an attempt was made to utilize both bone and cartilage. Part of the rib was to replace lost nasal bones, and the adherent costal cartilage to replace the septum. In theory at least, this was more sound than the utilization of cartilage alone, since the initial loss was of bone and cartilage, and the replacement of these tissues by similar structures would appear to be the ideal method. The distal one inch of either the seventh or the twelfth rib was resected, together with one inch of the attached cartilage. The rib was split and opened out to fit over the remnants of the nasal bones, while the projecting cartilage was fashioned to replace the septum. The graft survived satisfactorily, but it was found that the costochondral junction was insufficiently rigid, and bending occurred at this point which allowed the nasal tip to fall back. In addition the junction itself became thickened, and in the end, therefore, we were left with an inadequate tip support, together with a hump in the centre of the bridge line. The provision of an additional cartilaginous strut in the columella to control the collapse of the tip did not eliminate the recurrence of thickening at the costochondral junction.

Comment.—There is a great amount of American literature on this subject, published within the last fifteen years. Carter is perhaps the chief contributor, and the findings in this small series agree substantially with his results. Lyndon Peer has reported on cadaveric grafts, and is of the opinion that after much phagocytic action the cartilage itself does not remain as a recognizable entity, but is invaded and finally replaced by dense fibrous tissue. This is said to occur without any obvious change in the clinical appearance.

Curiously enough, none of the literature makes mention of the complication of distortion. It may be that American operators do not use cartilage for quite the same purposes for which we have utilized it. They may confine its use to relatively smaller defects in which but little stress is placed upon the transplant, and employ perhaps celluloid or ivory for the type of case referred to in this series. At all events, the use of cartilage in our hands was found to be so frequently complicated by failure to maintain the desired result that about seven years ago we commenced to utilize bone in its place.

2. BONE TRANSPLANTS

The first case of bone transplantation to restore the nasal bridge of which I can find record in this country was carried out in 1932 by Gillies. The donor area for the graft was the iliac crest. It appears that this site was chosen at that time chiefly on account of its accessibility; later experience leads me to believe that it has other and more important advantages.

The 115 cases here reported have been operated upon within the last six years: 8 are six years old; 20 are five years old; 22 four years old; 30 three years old; 20 two years old; and 15 were operated upon last year.

Indications.—The sites for which the grafts were used were: (*a*) restoration of the nasal bridge; (*b*) interstitial mandibular grafts for actual loss of continuity of the jaw; (*c*) superimposed grafts in the mandibular or maxillary regions to restore contour; (*d*) the reconstruction of frontal bone defect.

Operative Technique.—The anterior three inches of the iliac crest is exposed by an incision extending down to the bone. The attachments of the abdominal muscles to the crest and of the gluteal muscles to the outer surface of the ilium are cleared by blunt dissection. It is frequently convenient to remove the dense outer lip of the iliac crest as the next stage. The requisite piece of cancellous bone may consist of either part or whole of the blade of the ilium. Removal is effected by means of a broad osteotome; shaping is carried out by sharp cutting instruments, and during this process as much of the cortical bone as possible is eliminated. In other words, the transplant is designed to consist chiefly of cancellous tissue and to contain the minimal number of traumatized cells. The technique and preparation of the recipient area and of the insertion of the graft are similar to those employed when cartilage is used. The main difference is that the periosteum over the remnants of the nasal bones is raised to enable the transplant to lie in close contact with these bones.

FIG. 160.—An iliac bone-graft used to support the nasal bridge after an epithelial inlay. The original lesion was due to congenital syphilis.

Behaviour.—

1. Of the 115 cases here presented, 102 have been transplants to the nasal bridge; and in 66 of these bony union has been obtained with the underlying bones.

2. There does not appear to be any clinical or radiographic difference between those grafts which are adherent and those which are free.

3. The immediate local reaction of the recipient area is possibly a little greater than in the case of cartilage. This is probably due to additional trauma, accounted for by difficulty in the insertion of the graft.

4. From the clinical viewpoint there is very slight alteration in the appearance of the transplant except that irregularities tend to become rounded off during the first two or three months. Even when excessive stresses are placed upon the graft (as in the case of *Fig.* 160) no deviations have been seen.

5. After the initial period of slight alteration, the graft persists in an unchanged state. An exception to this is the behaviour of transplants made before ossification of the epiphysis of the iliac crest. In these instances the total bulk of the graft continues to diminish for as much as six months, and at the end of this time perhaps one-half of it has been absorbed. An explanation of this condition is given subsequently.

6. Reaction to infection is surprisingly good. Three cases have occurred. In one the graft was removed because of generalized cellulitic infection of the soft tissues of the nose and cheeks; this must have been due to an error in the operating theatre. In the other two cases a hæmatoma developed round the graft and subsequently became infected; immediate intravestibular drainage was instituted and no clinical loss was occasioned.

X-ray Investigation.—Fifty cases have been followed up, and the illustrations given are typical. There is no detectable difference between those grafts which have bony union with the skeleton, and those which have not. The following findings appear to be constant:—

1. Irregularities in contour become rounded off in about two months. During this period the graft decreases slightly in size, though this change is more obvious from the radiographic than from the clinical viewpoint (*Fig.* 161).

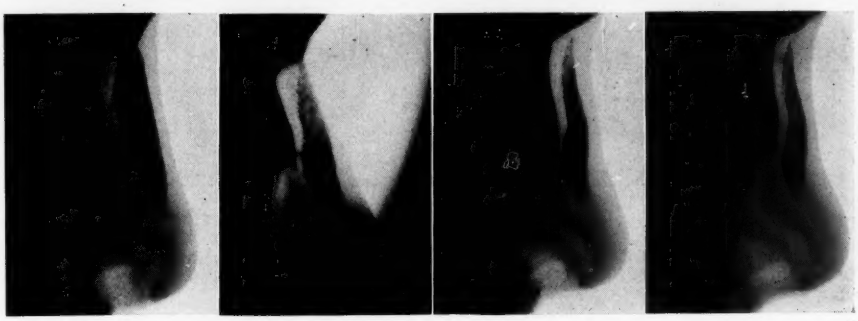


FIG. 161.—Iliac bone-graft not adherent to the nasal bones. A, Three weeks; B, Five weeks; C, Eight weeks; D, Twelve weeks.

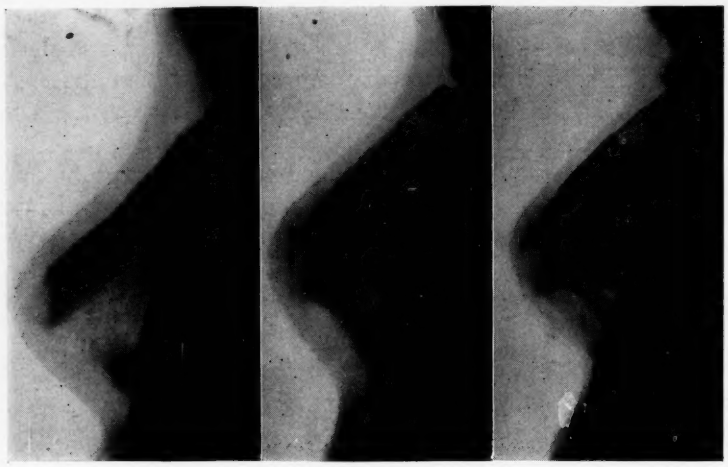
2. Within the same period the peripheral cancellous bone becomes replaced by an apparently normal cortical structure. In other words, that which was inserted

FIG. 162.—Iliac bone-graft adherent to the nasal bones. A, One month; B, Six months; C, Twenty-four months.

as a bone fragment becomes converted into a bone with normal radiographic characteristics in a matter of about eight weeks (*Figs.* 161, 162). The rapidity of this conversion would appear to preclude the possibility of initial death and subsequent invasion by new bone.

3. There is no phase of rarefaction, nor does the graft ever show X-ray characteristics which would suggest that it has become devitalized.

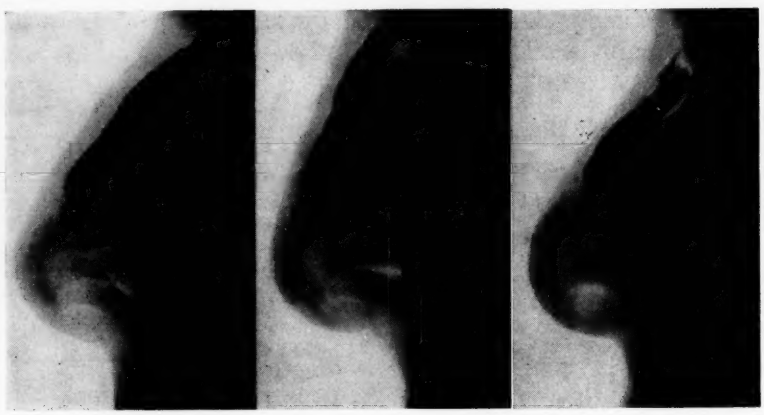
4. One graft superimposed upon another may acquire bony union with it (*Fig.* 163).



A B C

FIG. 163.—Superimposed grafts showing the new cortex round the cancellous structure and union between the transplants. A, Two weeks after the first graft; B, Nine months after the first and three months after the second graft; C, Six months later than the radiograph B.

5. The reaction to infection is apparently similar to that of normal bone, even though the infection occurs within one week of the transplantation (*Fig.* 164).



A B C

FIG. 164.—Infection occurred in a hæmatoma 48 hours after operation. Immediate drainage. A, Fourteenth post-operative day; B, Twenty-eighth post-operative day; C, Thirty months later.

6. Recent epiphysial bone and epiphysial cartilage become absorbed (*Figs.* 165, 166).

Histological Investigation.—This is difficult to carry out as there is seldom justification for interfering with a good result. It has, however, been possible to

obtain three sections, and the findings in these seem to bear out both the clinical and the radiographic investigations.

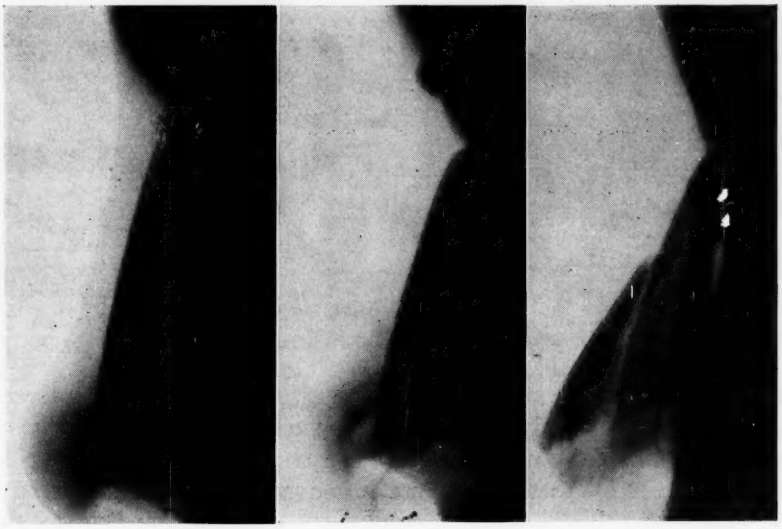


FIG. 165.—Showing absorption of epiphysial bone and cartilage. The secondary deformity was corrected by a superimposed graft. A, Two weeks after operation; B, Four months later; C, Eleven months later.

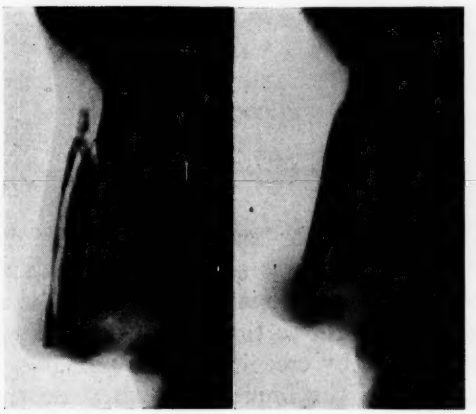


FIG. 166.—Absorption of epiphysial bone and cartilage, together with some recent iliac bone. The interval between the radiographs is approximately one year.

The first section (*Fig.* 167) is from the distal end of a non-adherent transplant. This graft had been inserted four months previously, and at that time the distal end of the graft consisted entirely of cancellous tissue. The section shows a relatively normal cortical bone structure surrounded by a dense layer of connective tissue which takes the place of the periosteum.

The second section (*Fig.* 168) is from the distal end of a graft which was adherent to the nasal bones. In this case also the area shown was originally cancellous tissue. Here again the structure is that of almost completely normal

cortical bone. The graft had been inserted four months before the section was taken.

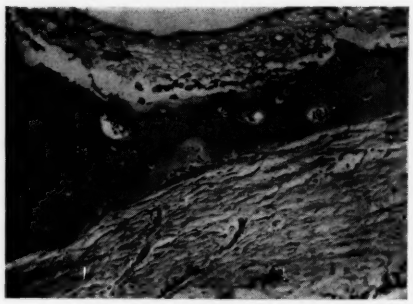


FIG. 167.—Section from the distal end of a non-adherent transplant.

FIG. 168.—Section from the distal end of an adherent transplant.

The third section (*Fig.* 169) is from the proximal end of an adherent graft. The area shown was cortical bone from the iliac crest when it was inserted. It lies within less than $\frac{1}{8}$ in. of the normal nasal bones, but in spite of this fact bone cells are infrequent and the lamellar structure is confused. It would appear to be almost entirely dead bone. It had been in position for five months. It would seem that in spite of a near attachment to live bone the cortical graft has died and even at the end of five months has not been replaced by living bone.

FIG. 169.—Section from the proximal end of an adherent transplant.

Comment.—Upon the subject of bone survival there is a wealth of literature and a correspondingly great diversity of opinion. There appear to be three main schools of thought.

The first follows Ollier's idea that the presence of periosteum is essential for bone survival. The theory has been elaborated as to how this survival occurs; some hold the opinion that the graft is vacularized and revitalized from the periosteum itself, whilst others think that those few bone cells which are adherent to the periosteum and survive with it subsequently replace the transplant by creeping substitution.

The second group are of the impression that periosteum does not play an essential part, though its presence may have some bearing upon the rapidity of regeneration. They hold the view that the original graft survives only as a scaffold, and that therefore it must be placed in contact with living bone. In other words, the graft is not osteogenic, but rather osteoconductive.

A third school is that which follows Leriche and Policarde, and who assert that osteoblasts are purely destructive in function. They state that a bone transplant succeeds only because it dies and provides the necessary source of calcium from which they state that any new connective tissue is capable of recreating bone.

A few individual workers may be said to form a fourth group who have come to the conclusion that survival of the graft is partly dependent upon its bulk.

From all these opinions there are dissenters, including Davis, who stated that a transplant of bone became absorbed even if it was in contact with living bone. Brown in 1938 was of the same impression. It is curious he should have come to this conclusion, since his work is based upon the type of graft which forms the substance of this paper. Practically all the other authorities have been working on experimental animals or have been investigating transplants for orthopædic purposes.

It would appear that these conflicting ideas may not be wholly irreconcilable, except perhaps those of Leriche and Policarde, which are so far out of line as to be almost untenable. The great majority of investigators have been utilizing transplants taken either from the crest of the tibia or from the radius. It seems probable that the bone cells in a transplant have the power of survival, but that this is dependent upon the rapidity with which they can acquire nutriment in their new position. This nutriment will, as in the case of any other grafted tissue, first be derived from blood-serum and tissue fluid, and only later from the ingrowth of any real vascular supply. It would therefore seem possible that the divergence of views may well be due to the use of different types of bone, since structurally

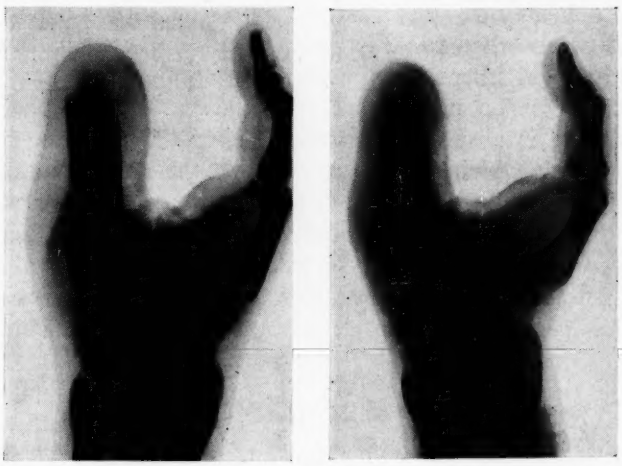


FIG. 170.—All four fingers were lost. An 'apposition post' was constructed from an abdominal tube-pedicle into which bone-grafts were inserted. The radiographs shown were taken one and four months after operation.

there is little in common between, say, a strip of dense tibia and a piece of cancellous ilium. If the transplant consists of dense cortical bone the only chance of the early establishment of nutrition to the bone cells will lie in the passage of serum or tissue fluid down existing vessels, or canaliculi, and these ports of entry will also be the only ones available for the ingrowth of capillaries. The mechanical barriers against the establishment of early nutrition would therefore appear to be so great that it is unlikely any appreciable proportion of the living bone cells in the transplant can be expected to survive. Under these circumstances a transplant of cortical bone may indeed be expected to die, though later it may be replaced either from those few islands which have managed to survive, or alternatively, if it be in apposition with living bone, by ingress of live bone cells from the bone with which it is in contact.

Now, if the transplant is mainly cancellous, a much greater proportion of the bone cells may be assumed to find nutriment available at an early period. The sponginess of the bone will favour its immediate bathing in serum and tissue fluid, and the ingress of arterioles will not be checked by any serious mechanical barriers. It is interesting to note that a cancellous transplant is found to be very vascular if it is exposed within the first two or three months. There are two other points which appear to me to bear out the suggestion that an early and adequate nutritional supply is essential to the actual survival of the graft. The first is that if cancellous bone is stored in the relatively avascular fat of the abdominal wall, it rapidly undergoes a gross degree of absorption which is in marked contrast with its behaviour when it is transplanted into the vascular tissues of the face. In *Fig.* 170 there will be seen a strip of dense bone lying between the two main grafts. This is a remnant of a graft which was originally the same size as its companions. It had been cut from the iliac crest 3½ months previously and stored in the abdominal wall until its final site was ready to receive it. On exposure at that time it had been reduced to about one-tenth of its original size and consisted entirely of cortical bone. Because of its obvious inadequacy it was necessary to cut the additional grafts shown in the figure.

The second point is that epiphysial and recent diaphysial bone shows considerable tendency to be absorbed (*see Figs.* 165, 166). One assumes that this is due to the fact that the bone cells here, being younger and more active, have a higher metabolic rate and therefore do not survive even the short transitional period during which their nutrition is absent or seriously decreased.

The rapidity with which cancellous bone on the surface of the transplant is replaced by cortical bone appears to me to be evidence of the activity of living tissue. It is of interest that neither radiographically nor histologically is there any apparent difference between the adherent and the non-adherent graft, so that the question of absorption followed by reconstitution from existing bone cannot arise. In none of these grafts has periosteum been left attached, so that this factor appears to be unimportant.

SUMMARY

It appears that for some purposes the use of cartilage as a transplant is vitiated by the tendency of approximately 25 per cent of these grafts to become distorted. So far no method of controlling this fault has been evolved.

For this reason iliac bone has been used in its place, and from the purely clinical viewpoint its behaviour is satisfactory. Radiographic and histological follow-up leads to the belief that this type of graft survives transplantation, and that this survival is dependent neither upon the acquisition of union with growing bone nor upon the presence of periosteum—rather would it appear to depend upon the fact that the bone structure is such that early permeation by tissue fluids enables the bone cells themselves to survive.

The use of dense transplants such as tibia, which may be satisfactory for purely orthopædic purposes, may not result in the actual survival of the transplant itself. This is due to the mechanical form of the bone, which prevents the early establishment of cell nutrition.

The divergent opinions expressed in the literature may, in fact, be due entirely to the utilization of different textures of bone as the basis for experiment.

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ELEPHANTIASIS OF THE PENIS

By J. COSBIE ROSS, Liverpool

Non-filarial elephantiasis of the scrotum and penis, sometimes described as 'elephantiasis nostras', is a rare condition and infrequently seen in this country. Ray[1] draws a distinction between elephantiasis and lymphscrotum, the latter being differentiated from elephantiasis by its reddish-brown colour, the presence of vesicles, either discharging or encrusted, and by the discharge of chylous fluid. Elephantiasis of the penis alone is described by McCrea,[2] but a survey of the literature does not reveal a reported case of non-filarial elephantiasis of the prepuce. Some authorities describe a further condition which is termed 'false elephantiasis'.

PATHOLOGY

Hinman,[3] in a clear and comprehensive survey, divides elephantiasis of the scrotum and penis into two varieties, elephantiasis arabum or tropicum, and elephantiasis nostras. He attributes the causation of the latter condition to the following:—

1. *Lymphatic Stasis.*—This in turn results from:—

a. Bilateral inguinal adenitis, which may occasionally be syphilitic in origin, is rarely due to lymphopathia venereum, and very rarely to tuberculosis.

b. Secondary blockage of the lymphatic trunks by scar tissue following inflammation or by surgical removal of the lymphatic glands.

c. Congestion by a low-grade bacterial infection of the lymphatics (usually streptococcal).

2. Secondary infectious alymphia.

3. Imperfect absorption of the products of inflammation, causing hypertrophy of the skin and subcutaneous tissues.

4. Recurrent attacks leading to progressive enlargement.

In addition to the above causes enumerated by Hinman, the factors of gravity and the dependent position of the penis and scrotum are also of importance. It is an everyday clinical experience to observe the rapid subsidence of peno-scrotal œdema when these structures are elevated on a platform of strapping running across the front of the thighs.

False elephantiasis of the penis may be produced by syphilitic hypertrophy, or by multiple fistulous tracts caused by bilharziasis of the urethra.

CLINICAL FEATURES

The skin may be smooth, but is commonly rough and fissured. The swelling feels firm and may be almost wooden in consistency; no pitting is observed as a rule. The diagnosis presents no difficulty as a simple clinical examination readily excludes the cases of false elephantiasis. The condition runs a chronic course and thus no confusion is caused by conditions causing acute swelling of the penis.

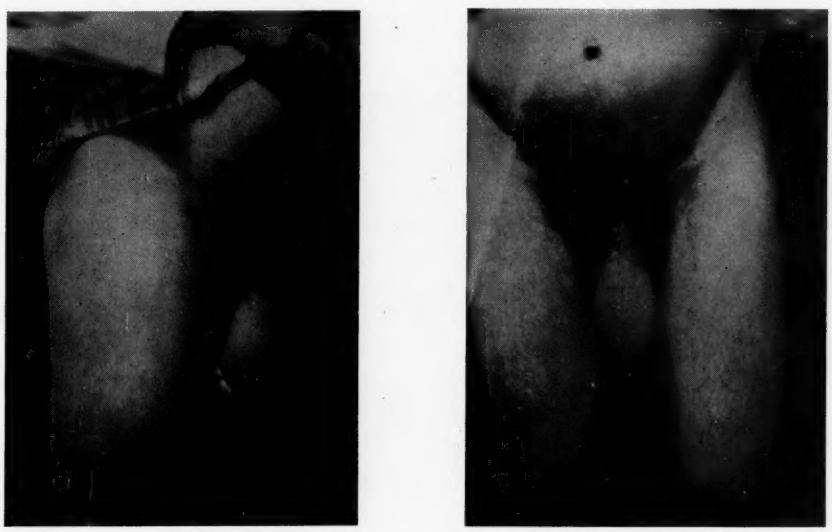
TREATMENT

The treatment of elephantiasis of the penis consists in the removal of the affected skin and subcutaneous tissue, and in covering the denuded areas with skin obtained by some plastic device. If the scrotum is not affected flaps may be fashioned from this, and undoubtedly scrotal skin is the most suitable substitute obtainable. Alternatively, if the scrotum is not available for this purpose, the denuded penis can be placed in a subcutaneous tunnel on the inner aspect of the thigh for ten days, and subsequently freed. Kretchmar has devised an ingenious operation for cases in which elephantiasis of the penis is combined with a similar condition of the scrotum. Right and left scrotal flaps and a rectangular penile flap are fashioned.

CASE REPORTS

Case 1.—B. G., aged 27.

HISTORY.—This man had complained of swelling of the penis for some years. Apparently six years previously, following drainage of a peritonsillar abscess, a tender, painful swelling developed in the left groin. He stated that the swelling in the groin was intensely inflamed over an area of about 2 in. in diameter, and remained in this condition for about nine days before an incision was made and much pus evacuated. The abscess drained for approximately a week and he was then despatched by taxi for X-ray examination. On returning to the Nursing Home he found the penis swollen, and this organ had never resumed a normal



FIGS. 171, 172.—Photographs showing the extent of the elephantiasis of the penis.

size since that date. At the time of examination the patient complained that the swelling of the penis was much more marked after standing at work during the day, and subsided a little when resting in bed. Slight dysuria was present and coitus was impossible.

ON EXAMINATION.—The penis was roughly the size of a large cucumber, the swelling being largely preputial; the length of the organ was 9 in. and the diameter approximately 3 in. (*Figs.* 171, 172). There was some secondary balano-posthitis. Both skin and subcutaneous tissues were much thickened. The scrotum appeared normal, and there was an old scar present near the pubic spine on the left side.

AT OPERATION.—The enormously enlarged prepuce and penile skin to a point proximal to the corona were excised. The 'mucosal' layer of the prepuce was not swollen, so a fringe

of this was used for subsequently covering the bare area. The remaining skin of the penis proximal to the corona was undermined, and the œdematous subcutaneous tissue excised. On measurement, the thickness of the prepuce on the dorsum was exactly 1 in. Suture was carried out in the usual way, but as there were two large potential spaces, a piece of rubber drainage tissue was inserted on either side. Following operation the skin at the suture line on the dorsal aspect became bluish-purple in colour and it was apparent that undermining had been carried as far as was possible.

His progress following operation was most satisfactory, and when reporting recently the patient stated that he had now no dysuria and that coitus was possible with a little difficulty. On examination there was still some subcutaneous thickening behind and below the glans penis, but the result was satisfactory on the whole. It was proposed to carry out a small additional procedure, excising the thickening on the ventral surface, but the patient refused this on the grounds that he was well satisfied with the result.

Professor T. B. Davie, who examined the specimen removed at operation, reported as follows: "The main feature is a marked fibrous thickening of the subepithelial connective tissue. There is also some lymphocytic infiltration around the vessels and a number of vascular spaces which are almost certainly dilated lymphatics."

Case 2.—Flour miller, aged 49.[4]

This man had a bloc dissection of the glands of the groin on both sides, carried out by me for epithelioma of the scrotum in 1933. The operation was of a widespread character, and owing to the undermining of the skin both wounds broke down, as so frequently occurs in these cases. When examined some years later, while there was no sign of local or glandular recurrence, there was a condition of mild, but definite elephantiasis of the penis, which was, however, quite symptomless.

DISCUSSION

I have been unable to find a reference in the literature to elephantiasis affecting the prepuce alone. In the first case described, the important aetiological factor appears to have been the long period which elapsed before the abscess was incised and drained. If any conclusion can be based on a solitary case, it would appear advisable to drain these cases of abscess of the groin earlier rather than later. Morley[5] many years ago pointed out that the lymphatic trunks carrying lymph from near the scrotal raphé are superior in position in relation to the other trunks in the vicinity of the external abdominal ring, and further pointed out that these lymph-trunks passed to glands situated just internal to the anterior superior iliac spine. In this particular instance (*Case* 1), it appears probable that those trunks draining the prepuce were divided, or subsequently involved in the scar tissue. In view of the early development of the swelling on assuming an upright position the former is the more probable. Finally, it is perhaps of interest that in spite of the great swelling present (and well shown in the photographs), a relatively simple operation largely consisting of a modified circumcision was effective in curing the condition.

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CLEFT PALATE AND THE MECHANISM OF SPEECH*

By MICHAEL C. OLDFIELD

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SPEECH is representative of man's highest intellectual attainments. Robert Louis Stevenson[1] once said, "The first duty of a man is to speak; that is his chief business in this world".

If a surgeon can ensure normal speech for a patient with a cleft palate, the outlook of his whole life will be altered. To do this efficiently, it is essential to understand the mechanism of normal speech.

ANATOMY OF THE PALATE AND NASOPHARYNX

The hard and the soft palates differ in their development, function, and structure. The hard palate is merely an inert partition between the nose and mouth, whereas the soft palate, which is a comparatively recent acquisition in evolution, has an intricate structure and complicated duties to discharge. It appears to represent the anterior extremity of the dorsal pharyngeal wall, the nasopharynx being part of the nose and not the pharynx. Functionally, the soft palate may be considered as composed of three unequal segments (*Fig.* 173).

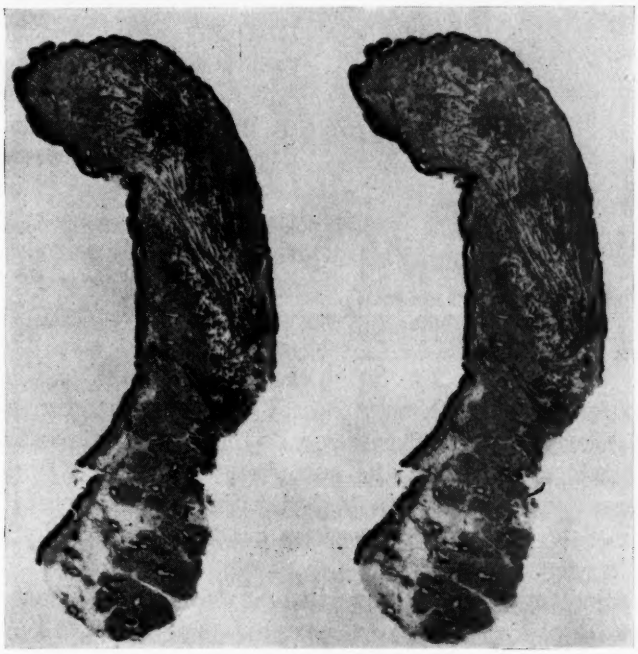

FIG. 173.—Longitudinal section of the soft palate, showing the anterior, middle, and posterior segments.

* An Arris and Gale Lecture delivered at the Royal College of Surgeons of England on Feb. 12, 1940.

The thin anterior portion of the soft palate consists of the palatine aponeurosis, covered on each surface by mucosa and submucosa, which is rich in glandular tissue. It contains few muscle-fibres and has no intrinsic motor power. It is acted upon rather like a sail, being stretched or loosened by the tensor palati. As it consists mainly of fibrous tissue, it is especially liable to post-operative contracture.

The middle segment is muscular and contains an involved system of motor units. The rapidity and range of its actions during articulation are truly remarkable. For instance, by the action of the levator it can be arched into close contact with the posterior and superior wall of the nasopharynx, and it is this middle segment of the soft palate which forms the valve to occlude the nasopharyngeal isthmus, not the posterior segment, as many anatomists seem to believe.

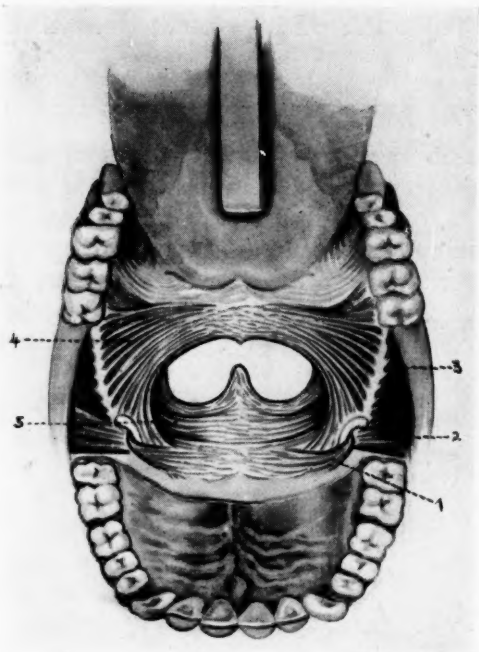

FIG. 174.—Muscles of the palate and nasopharynx with the head in position for repair of a cleft palate. 1, Tensor palati; 2, Internal pterygoid; 3, Buccinator (divided); 4, Superior constrictor; 5, Levator palati.

The posterior segment, including the uvula, has a passive role and does not seem to be capable of independent action. Most of the time it hangs downwards in a flaccid state and only appears to be towed into position when the middle segment contracts. The whole of the posterior third of the soft palate is covered by stratified squamous epithelium, whereas the rest of the palate is covered only on the buccal surface by stratified squamous epithelium, and on the nasal surface by ciliated columnar epithelium.

The soft palate is particularly rich in mucous glands, and often at the beginning of a cleft-palate operation beads of secretion can be seen all over the surface of the uvula and posterior third of the soft palate. In the anterior part of the palate most of the glands are placed at the side, but behind they are aggregated near the midline and form the main mass of the uvula.

Although a definite uvula is only present in monkeys and men, Wood Jones[2] has shown that in many of the other mammals there is an aggregation of glandular tissue on the anterior margin of the nasopharyngeal orifice, forming a median tubercle. It seems probable that in evolution this glandular tubercle culminates in the formation of the uvula, which becomes pendulous as the larynx is withdrawn from the nasopharyngeal orifice.

The early tumescence of the uvula in inflammatory conditions, as well as its morphology and its passive role in nasopharyngeal occlusion, all suggest that the uvula has a glandular rather than a mechanical function.

To unravel the secrets of the soft palate mechanism, it is essential, at first, to isolate the muscle components, and then to study their actions independently (*Fig.* 174).

The Levator Palati muscles may be considered as a single unit consisting of two muscle bellies acting upon an intermediate tendon, in much the same way as the digastric. It acts as a sling to lift the soft palate upwards and backwards, working from two fixed points on each side of the base of the skull. The muscular fibres arise from the petrous portion of the temporal bone and coalesce to form two cylindrical fasciculi. These pass downwards, inwards, and forwards over the upper border of the superior constrictor. This muscle is reinforced here to form another sling acting in a plane at right angles to the levator, but working in unison with it.

The muscular limbs of the levator pass into the upper surface of the soft palate below the tubal orifice, where the sling is completed by a tendinous aponeurosis (*Fig.* 175).

The muscles come into play during speech, contraction and relaxation of the two limbs occurring with invisible rapidity. The whole of the soft palate is raised,

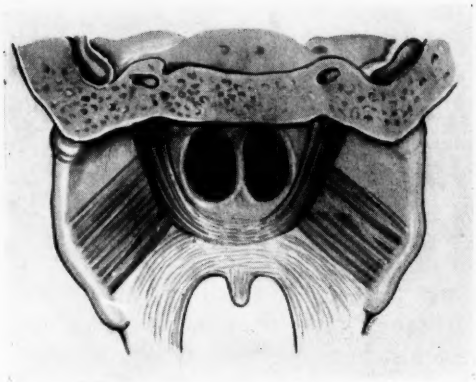

FIG. 175.—Levator sling from behind.

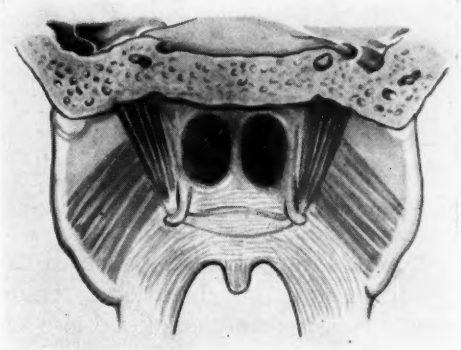

FIG. 176.—Tensor sling from behind.

but the convexity of the middle third of the upper surface is accentuated most of all. Wardill and Whillis[3] made direct observations upon the upper surface of the palate during speech in a patient, part of whose nose had been removed for an extensive rodent ulcer. They noticed that the mucosa on the upper surface of the palate, at the site of insertion of the levator palati, was raised into a cushion, which made contact with the ridge of Passavant.

In cases in which the soft palate is cleft, the sling is incomplete in the midline, but its efficiency is soon re-established when the palate has been accurately repaired. The function of the levator in speech is most important, and it must on no account be divided in the lateral relaxation incision. Fortunately, it is easily avoided and does not appear to cause any lateral tension on the flaps.

The Tensor Palati muscles may also be considered as a single unit, composed of two flat muscular lamellæ, acting through narrow tendons upon the palatine aponeurosis. The muscular pillars arise from the inner surface of the highest part of the external pterygoid plate, the scaphoid fossa, and the cartilage of the Eustachian tube. Fibres converge in a fan-like manner upon a strong tendinous cord, which passes vertically downwards along the inner surface of the internal pterygoid muscle. The tendon passes to the other side and then below the neck

of the hamulus, where it makes a right-angled turn, and is inserted into the palatine aponeurosis. The hamulus, the exact position and development of which varies considerably in different individuals, acts as a pulley, altering its line of action from the vertical to the horizontal plane, i.e., making the muscle a tensor instead of a levator. The tensor sling, on contraction, tightens the palatine aponeurosis and reduces the upward convexity of the anterior portion of the soft palate (*Fig.* 176).

Wardill and Whillis,[3] from their observations of the movements of the upper surface of the soft palate, noticed the formation of dimples, in the position of the tensor palati insertions, during the act of deglutition. When the muscles contract they flatten and lower the level of the palatine aponeurosis, and, in this way, they assist the tongue to drive a bolus of food into the pharynx.

When the soft palate is cleft the two halves of the tensor sling act independently, and tend to draw apart the edges of the anterior portions of the soft palate. This is the thinnest and weakest part of the sutured palate, and therefore it is important to abolish this action of the tensor when repairing a cleft palate.

Liston[4] emphasized the importance of this procedure in 1846, and advised division of the tendon. In 1889, Billroth[5] suggested dividing the medial pterygoid plate near the base of the hamular process instead of the tendon.

It has now become a well-established procedure in cleft palate operations to fracture the hamular processes (Wardill,[6] 1928, Dorrance,[7] 1932, Kilner,[8] 1935, Axhausen,[9] 1936). By this means the tendons are freed and allowed to slide inwards and backwards. The pulley at the hamulus is removed and the right-angled turn obviated. The line of action of the muscles, now being upwards instead of outwards, becomes similar to that of the levators and reinforces their power of lifting the soft palate to close the nasopharyngeal aperture. In normal conditions it is thought that the tensor sling acts principally as a muscle of deglutition. It is probably employed also as an antagonist to the levators during speech; but in cleft palate cases, by fracturing the hamular processes, it can be enlisted as a protagonist of the levators.

The Glossopalatine muscles form an incomplete sphincteric ring and tend to draw the soft palate downwards and away from the postero-superior wall of the nasopharynx. Their fibres are continuous across the under-surface of the soft palate, and pass downwards in the anterior pillars of the fauces to the sides and dorsum of the tongue. It is possible that these muscles come into play to allow nose-breathing during mastication of food by drawing the soft palate downwards into contact with the tongue. Later, when the bolus reaches the back of the tongue, they help to propel it into the pharynx.

These muscles, being antagonists of the nasopharyngeal sphincter, may be divided during the repair of a cleft palate if they appear to be the cause of lateral tension. No apparent interference with swallowing is noted afterwards and Denis Browne[10] divides the muscle as a routine procedure at each operation. He has not reported any adverse effects in over 200 cases treated in this way.

The Azygos Uvulæ are two small muscle-bundles which arise from the posterior nasal spine, pass longitudinally backwards near the midline of the soft palate, and are inserted into the uvula.

When repairing a cleft palate, the muscles are usually separated from the posterior nasal spine during the elevation of the nasal flaps of mucosa. These muscles can be defined by undercutting the buccal and nasal mucosa near the

edges of the cleft and when sutured in the midline—as suggested by Axhausen[9]—they form a useful third line of support.

The Superior Constrictor has long been known to act synergically with the soft palate during speech and deglutition. Its upper fibres act as a sphincter of the naso-pharyngeal orifice.

The superior constrictor, which is a quadrilateral curtain of muscle lying on each side and behind the upper part of the pharynx, is often described as being composed of four groups of fibres (*Fig.* 177):—

1. *Pterygopharyngeus*, arising from the hamular process.

2. *Buccopharyngeus*, arising from the pterygo-mandibular raphe.

3. *Mylopharyngeus*, arising from the posterior third of the mylohyoid line of the mandible.

4. *Glossopharyngeus*, arising from the side and root of the tongue.

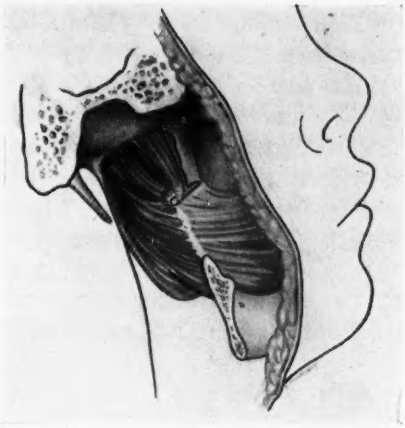

FIG. 177.—Superior constrictor, lateral view, showing the four main fasciculi: pterygo-pharyngeus, buccopharyngeus, mylopharyn-geus, glossopharyngeus.

These muscle-fibres are inserted into the median pharyngeal raphe which is prolonged upwards to the pharyngeal spine on the basilar process of the occipital bone. The levator palati and Eustachian tube pass over the upper free border of the muscle; the interval between this and the base of the skull is closed by the pharyngeal aponeurosis and is known as the sinus of Morgagni. The pharyngeal aponeurosis suspends the pharynx from the base of the skull.

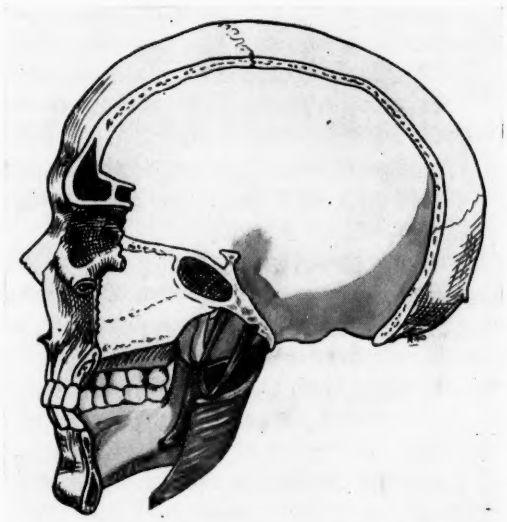

FIG. 178.—Levator and superior constrictor slings, showing the thickened upper free border of the superior constrictor, which on contraction elevates and approximates the limbs of the levator sling and in this way serves to reinforce its lifting power.

The upper group of fibres is concerned with both speech and swallowing, the lower groups with swallowing only.

In 1845 Sir William Fergusson[11] described a dissection that he had made upon an adult subject with a cleft palate. He noted that "the superior constrictor muscle is more fully developed than under ordinary circumstances and its upper margin, extending between the basilar process of the occipital bone and the internal pterygoid plate, is particularly distinct. This part of the muscle forms a sort of semicircular loop, in which the levator palati muscle seems to be suspended." (*Fig.* 178.)

Gray[12] and Spalteholz,[13] as well as many other anatomists, describe the muscle

as arising from the lower third of the internal pterygoid plate. Whillis,[14] in numerous careful dissections, showed that the muscle arises merely from the hamulus and not the pterygoid plate. We have confirmed this finding in all our dissections.

Passavant,[15] in 1863, described a specialized transverse fasciculus of the superior constrictor muscle, which, by its contraction, raised a cushion of mucous membrane on the posterior pharyngeal wall

Whillis[14] described in detail the anatomy and function of the upper fibres, and named this portion of the muscle the ' palato-pharyngeal sphincter '. He described a constant band of fibres which passes forwards from the superior constrictor into the soft palate, where it is inserted into the palatine aponeurosis. The superior constrictor in its upper part seems to consist of two lamellæ ; a lateral lamella attached to the hamular process and a medial lamella passing into the soft palate. This medial sphincteric band is on a level with the ridge of Passavant.

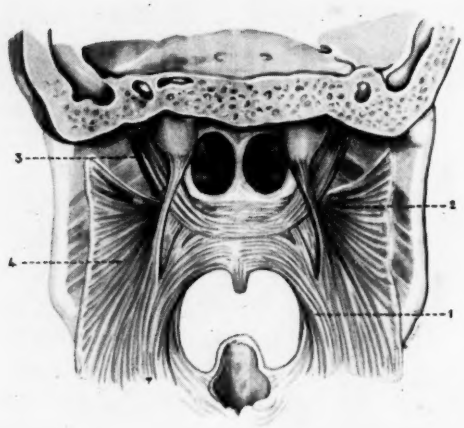

FIG. 179.—Pharyngopalatine (1), salpingopharyngeal (2), levator palati (3), and superior constrictor (4) muscles from behind.

The Pharyngopalatine muscle is usually described as arising from the posterior margin of the thyroid cartilage and the pharyngeal aponeurosis. Its fibres curve laterally at first, to lie on the side wall of the pharynx, then pass medially into the posterior pillar of the fauces. Near the medial extremity of the posterior pillar the muscle divides into two fasciculi, which are separated from one another by the levator palati passing down to its insertion. The two strands finally become attached to the upper part of the palatine aponeurosis (Blakeway,[16] 1914).

Wood Jones[2] has recently expressed the view that the usual conception of the pharyngopalatine muscle as composed of two fasciculi, is inaccurate. He believes that, morphologically, it represents two distinct muscles. Only the upper part is the true palatopharyngeus, and this encircles the nasopharyngeal orifice as a sphincter. He believes that these fibres are identical with the fasciculus described by Luschka[17] and called by Whillis[14] ' the palato-pharyngeal sphincter ', but represent an anatomical entity and not a special fasciculus of the superior constrictor. The lower fibres, which extend from the palate to the larynx, represent another muscle, which he calls ' m. palatothyroideus '.

The Salpingopharyngeus arises from the cartilage of the Eustachian tube and descends along the lateral wall of the nasopharynx towards the lower and outer extremity of the posterior pillar of the fauces where it blends with pharyngopalatine and superior constrictor fibres (*Fig.* 179).

The pharyngopalatine and salpingopharyngeal muscles together form a lateral sling which, on contraction, rises up to occlude the outer part of the isthmus. They function as the lateral element of the nasopharyngeal sphincter.

Wardill and Whillis,[3] when viewing the upper surface of the palate, noticed that the salpingopharyngeal fold, which in the resting stage formed a ridge, concave medially, straightened out during speech. By contraction of its contained muscle an outstanding fold was formed just below the Eustachian tube. The posterior pillars, in a similar way, can be seen from inspection from below to straighten out and help to diminish the side-to-side measurement of the nasopharynx.

We made observations* on the movements of the soft palate and posterior pillars of the fauces upon a patient with a ' cut-throat ', who had a large defect in the anterior wall of the pharynx. When he attempted to make oral consonant sounds and when saying ' Ah ', the posterior pillars contracted and appeared to occlude the side of the nasopharynx.

The Mechanism of Closure of the Nasopharyngeal Isthmus.—Air-tight closure of the isthmus is recognized to be essential for perfect speech after the repair of a cleft palate. When the valve is incompetent, explosions of air, which occur in the mouth in the formation of most of the important consonant sounds, fail to occur because air leaks away through the nose.

Wardill[18] believes that the nasopharyngeal valve consists of two parts—a palatal and a pharyngeal—which work together in harmony. Closure of the palatal part is effected by the levators, which draw the palate upwards and backwards towards the posterior wall of the nasopharynx. The pharyngeal element is formed by the upper horse-shoe fibres of the superior constrictor which are inserted into the soft palate on each side and form a horizontal loop behind the posterior wall of the nasopharynx.

These fibres remain in a state of tonic contraction throughout speech, forming the ridge of Passavant, which acts as a " valve seating for the upper surface of the soft palate ". Only when speech ceases does it relax, and everyone can confirm upon himself Wardill's observation that there is a " feeling of slow relaxation which normally occurs in the posterior pharyngeal wall on cessation of speech ". Wardill and Whillis[3] have confirmed their theories by direct observation of the upper surface of the palate and its movements during speech. Dorrance[7] has made similar observations under similar circumstances and confirmed these findings.

The lateral portion of the nasopharyngeal isthmus was seen to be occluded by contraction of the salpinopharyngeal muscles, and we believe that the pharyngopalatine muscles also help to occlude the lateral part of the nasopharynx. It would appear that, on contraction, the levator sling fixes the upper end of the pharyngopalatine muscle which embraces it in the palate. Acting from this point the pharyngopalatine muscle is able to draw the posterior pillars upwards to obliterate the side of the nasopharynx.

Denis Browne[10] disagrees with Wardill's theory of tonic contraction of the constrictor during the whole period of speech. He believes that Passavant's ridge rises and falls many times during each phase, corresponding to the excursions of the soft palate. He postulates the action of " two overlapping slings of muscle ".

The Wardill hypothesis, that the constrictor ridge of Passavant remains continuously erect during speech, seems more likely to be correct. The mechanism of closure of the nasopharyngeal isthmus by a series of overlapping muscular slings

* A coloured cinematograph film was shown, demonstrating the movements of the soft palate and the posterior pillars.

is, however, a rational explanation of the sphincter mechanism. Probably more muscular slings are involved than the two postulated by Denis Browne :—

1. *Levator sling.*

2. *Superior constrictor slings* :

a. Horse-shoe fibres inserted into each side of the soft palate and passing transversely round the pharynx, forming Passavant's ridge. Whillis's " palato-pharyngeal sphincter ".

b. Fasciculus forming a thickening of the upper free border, attached to the hamulus in front and to the pharyngeal spine behind, reinforcing the levator sling.

3. *Salpingopharyngeus and pharyngopalatine muscles*, occluding the outer part of the isthmus by drawing the salpingopharyngeal folds inwards, and the posterior pillars upwards.

In this way, by the synergic action of overlapping muscle slings, the posterior wall of the isthmus is drawn forwards, and the lateral walls inwards. In front the soft palate is raised and drawn back and its middle third is curved upwards, forming a valve which occludes the narrowed isthmus.

Blood-supply of the Palate.—The palate receives an extravagant arterial supply, a fact of great importance in cleft-palate surgery. At operation the blood loss is out of all proportion to the extent of the surgical interference. It is of great importance, therefore, to re-establish the blood-volume at the end of the operation. Adequate arrangements must be made for the removal of the blood from the scene of operation by reliable methods of suction ; otherwise the surgeon's vision will be repeatedly obscured and the operation time prolonged to a dangerous extent. On the other hand, flaps can be cut which would be in serious danger of sloughing in many other parts of the body.

In most operations, to secure adequate lateral relaxation, the posterior palatine arteries, which provide the main blood-supply, are divided on each side. An abundant collateral anastomosis is soon established provided the patient does not suffer from severe anæmia during the first few days after operation.

AETIOLOGY OF CLEFT PALATE

The palate is a fairly recent acquisition in the evolutionary process and it is only fully developed in the mammals. In the lower vertebrates the palate is incomplete ; there is no soft palate, and the hard palate is often absent or cleft. The most primitive soft palate occurs in birds and is perforated by the hiatus naso-pharyngeus, directly beneath which lies the opening of the larynx on the floor of the mouth. In certain types of mammal, for instance the whale, there is a direct passage from the nose into the larynx and trachea, which is an adaptation to aquatic life. The buccal cavity and pharynx can be shut off completely from this air passage, and food passes on each side of it through bilateral channels, remnants of which, according to Wood Jones,[2] are represented by the pyriform fossæ. This arrangement is ideal for the purpose of breathing and eating simultaneously, but is incompatible with vocalization.

In certain mammals, like the pig, in which eating is a prominent function but in which vocalization is occasionally necessary, the laryngeal orifice is habitually elevated into the nasal cavity, but can be dropped below the soft palate for an occasional squeal. Most mammals throw back their heads as a preliminary to any

sustained vocal effort, and Wood Jones[2] has shown that this is not an aid to the dissemination of the voice, but a necessary preliminary in animals in which the epiglottis is habitually in an intranarial position. A dog, he says, may growl with a flexed head, but it is doubtful whether he can bark or howl to much effect without extension of the head.

The wide separation of the laryngeal from the nasopharyngeal orifice has made vocalization possible; this has reached, in evolution, its climax of efficiency with the development of speech in man. Bland Sutton,[19] in 1889, showed that the epiglottis was often intranarial in the human fœtus until the fifth month of intrauterine life.

The life history of the individual mammal thus recapitulates the history of the race, and, if the process of fusion of the palate is hindered during development, a cleft palate results. It has been noted in many types of mammal besides man, and has been reported in cattle, sheep, horses, dogs, cats, lions, foxes, and rabbits (Hobday,[20] 1922; Veau,[21] 1938).

Development may be retarded by ill-nourishment, and the more recent acquisitions in evolution suffer first. Experimental work upon the embryos of certain lower animals has revealed the fact that a high percentage of anomalies occur when the concentration of the salts in the fluid in which the embryo developed is altered. If the amniotic fluid surrounding a human fœtus was altered, it would seem possible that incomplete development of the fœtus might result. In nature, such altered composition of the amniotic fluid might occur if the mother suffered from malnutrition.

Dr. Strauss[22] and Petrus Olson, who studied the congenital abnormalities of the animals in the Berlin Zoo, made the observation that imperfect nutrition may be a causal factor in the production of cleft palates. They reported that, in 1909, thirty-two jaguars were born with cleft palate. They were all from one dam by the same sire. The diet was then changed and fresh meat was given, after which no further cleft palate offspring were born from the same two parents. Pickerill[23] states that 99 per cent of the lion cubs born at the Zoo in Regent's Park towards the end of the last century suffered from cleft palate. Since 1923, when Dr. Vevers[24] altered the diet of the lionesses, only two litters have been born with cleft palates.

It is a well-known clinical fact that cleft palate is rare in the well-to-do, and much more often seen in the children of poor parents. There are many such indirect items of experimental and clinical evidence to suggest the importance of improper nutrition as one aetiological factor in the causation of cleft palate.

The importance of the hereditary factor is generally accepted, and is probably the most important one in a certain number of cases. In about 20 per cent a definite family history can be traced, but in some cases the forebears have been noted to have an upper lateral incisor tooth of small size or absent since birth (Clement Lucas,[25] 1888). In certain families the tendency to cleft palate is inherited only through the females.

Mental deficiency occurs eight times more frequently in cleft-palate patients than in an unselected group of people (Bolling,[26] 1928). In 120 cases of cleft palate, we found 4 cases of gross mental deficiency and 3 cases of definite subnormal mentality. It is to be expected that if one part of the body is ill-developed, there

is a tendency for other parts to be similarly affected, and about 20 per cent of cleft-palate cases have other congenital defects, apart from hare-lip. Hare-lip was associated with the cleft palate in 62·5 per cent of our cases and 2 cases were associated with hypertelorism (Greig,[27] 1924; Oldfield,[28] 1938).

ANATOMICAL TYPES OF CLEFT PALATE

It is important to classify the anatomical types of cleft palate for statistical purposes, as well as for comparing the results of treatment. Veau's method of classification is the simplest and most practical; he describes four types (*Fig.* 180).

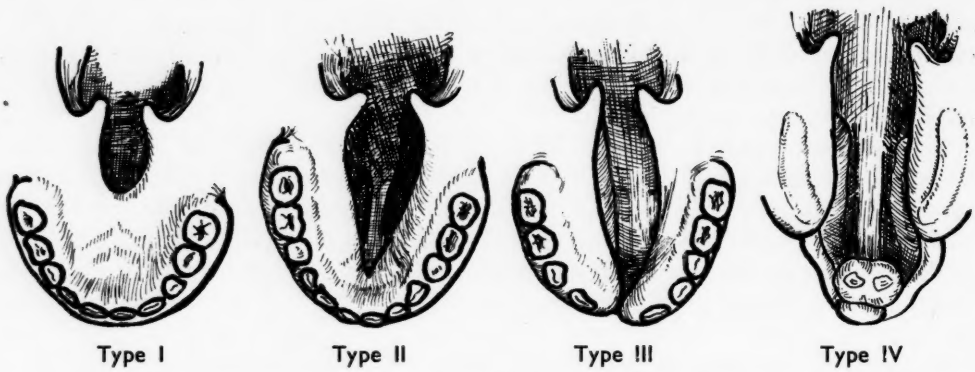

FIG. 180.—*Veau types of cleft palate*: Type I, Cleft of soft palate or uvula. Type II, Cleft of hard and soft palate, extending no further than the incisive foramen. Type III, Complete unilateral cleft of the alveolar arch and hard and soft palate (usually associated with unilateral hare-lip). Type IV, Complete bilateral cleft of the alveolus and hard and soft palate. The vomer and premaxilla are not attached to either side, but are suspended from above (associated with bilateral hare-lip).

The vomer in Type II may be suspended from above and free from each side of the cleft, or attached to either side. In Type III the vomer is usually attached to that side of the palate which is opposite to the cleft in the alveolus.

The width of the cleft is greater, and the shortening and deficiency of the lateral elements are usually more marked, in Types I and II than in the complete clefts involving the alveolus. In the latter, the cleft is often narrow, especially if the hare-lip has been repaired in infancy; there is little or no deficiency of the lateral elements, but the palatal processes of the maxillæ are more vertical than usual. These anatomical facts are an important consideration when choosing the kind of operation to perform for the repair of each type of cleft.

The Question of Deficiency of Tissue.—There has long been a controversy as to whether, in cleft-palate cases, there was actual deficiency of tissue (Keith,[29] 1909; Frazer,[30] 1917; Wardill,[6] 1928), or merely separation of the lateral elements. Peyton,[31] after taking careful measurements in twenty-six cases of cleft palate, and upon a comparison with 91 normal subjects, concluded that there was probably no significant difference in the surface width of the palate in the normal and cleft palate child, but the dome of the palate was distinctly higher than in the normal. We believe that the solution to the problem is that there are two types: those with deficiency and shortening of the lateral elements, occurring most commonly in Types I and II, and those in which there is merely separation of the normal constituents.

Besides the changes in the soft tissue, abnormalities are often seen in the architecture of the skulls of cleft-palate cases. Wardill[6] concluded from skull measurements on museum specimens, together with similar measurements by Veau, that there was associated with cleft palate a small but definite increase in the transverse diameter of the nasopharynx, as well as asymmetry of the face and vault

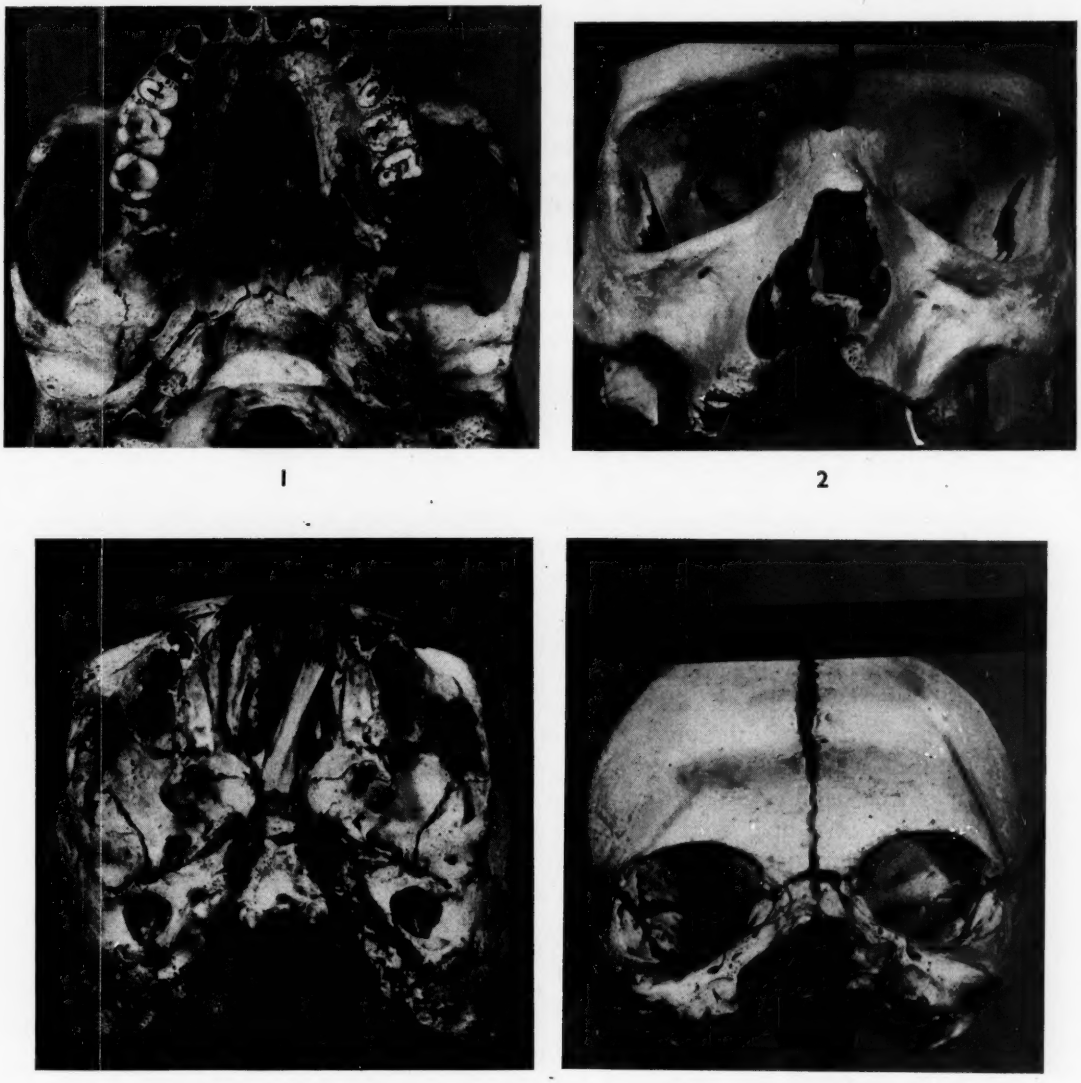

FIG. 181.—Photographs of cleft-palate skulls: 1, Veau Type II from below; 2, Veau Type III from in front; 3, Veau Type IV, (a) from below, (b) from in front, *(By kind permission of the Curator of the Royal College of Surgeons' Museum, London.)*

of the skull. This observation was also confirmed by Alex Limberg.[32] Trendelenburg[33] concluded that the facial portion of the skull was wider than normal when the palate was cleft. (*Fig.* 181.)

THE TREATMENT OF CLEFT PALATE

As the main disability of a patient with a cleft palate is that he is unable to speak so that he can easily be understood by strangers, treatment should be designed primarily to forestall or remedy the defect in speech.

Age.—It is most important to repair the palate before the patient is two years old, when speech is developed. The ideal age for operation is between one and two years. If operations are undertaken on younger children, the death-rate rises considerably. For fragile patients with extensive clefts, it is wise to delay operation until the child is between $1\frac{1}{2}$ and 2 years old. Lane's[34] results, when operating upon very young children, were exceptional, but the mortality-rate amongst the patients of those surgeons who followed his example was tragic.

Nearly all figures relating to cleft-palate operations, undertaken on a number of children under one year, reveal a mortality of about 10 per cent or more. Veau's[35] figures show the relationship of mortality to age. He states, " *Le facteur primordial de gravité est l'âge de l'opéré.* La mortalité va en décroissant avec les années."

Under 1 yr.	*Under 2 yr.*	*Under 3 yr.*	*Under 4 yr.*	*Total*
9·4	5·7	2·7	1·8	3·8

There is no object in operating upon patients under 1 year old, as far as speech is concerned, and the risks are undoubtedly increased.

Operation after the age of 2 years is less satisfactory, because it is important for the palate to be functioning before speech is acquired. Fortunately, speech is usually learnt rather later in cleft-palate patients than in normal children. If operation is completed satisfactorily before the child is 2 years old, favourable speech is acquired in a high percentage of cases. At present, however, quite a number of primary cases, and a much larger number of secondary cases, are not seen by the cleft-palate surgeon until after they are 2 years old. In these circumstances they can only be treated as soon as possible after they are seen. Nevertheless, even in adults, if thorough speech training follows operation, marked improvement in speech usually follows repair of the palate.

Contra-indications to Operation.—It is only on rare occasions that operative treatment should be denied to a case of cleft palate. Serious mental deficiency (3 cases) and uncompensated congenital heart disease (1 case) were considered as contra-indications to operation, and were present in the 4 patients not treated by operation in our consecutive series of 120 cases.

Preparation for Operation.—The majority of cleft-palate children are fragile, anæmic, and undernourished. This is due not only to the difficulty these children have in taking their food, but also because cleft palate occurs usually in the children of poor parents.

Careful and often prolonged preparation for operation is of great importance. When an abundant and nutritious diet containing plenty of vitamins is given, improvement is often remarkable. The guidance of a pædiatrician is invaluable, and it is wise to arrange for the child to be admitted to hospital at least a week before operation is contemplated. A thorough medical examination can then be made, the diet adjusted, and the child has time to recover from the period, soon after his admission, when he frets pitifully for his mother.

Operation is delayed in the presence of: (1) Carious teeth; (2) Grossly infected tonsils; (3) The throat swab showing hæmolytic streptococci or diphtheria bacilli

on culture; (4) Active middle-ear disease; (5) Active upper or lower respiratory tract infections; (6) Hæmoglobin percentage under 70.

Carious teeth are extracted and the sockets which are left must have healed before operation is undertaken. Routine tonsillectomy, as practised by some surgeons, seems to be unnecessary and in fact a disadvantage, because it is probable that the tonsils play an important role in combating oral infection in the post-operative period. Tonsils are removed by dissection, only if they are obvious foci of sepsis, that is, when they are grossly inflamed, and associated with cervical adenitis, anæmia, and general debility.

It is probably advisable to group the blood of all cases in which an extensive operation is contemplated, and for most of these it is prudent to find a suitable blood donor, by direct tests, before operation is undertaken.

OPERATION

Anæsthesia.—Intratracheal gas, oxygen, and ether are administered through a fairly rigid Magill's tube, passing over the centre of the tongue. The tube is kept clear of the field of operation by the tongue-piece of a Kilner's Shadwell gag. The lower part of the pharynx is packed with gauze soaked in sterile liquid paraffin.

Position.—The patient lies upon a hot-water bed, and a pillow and a small sand-bag are placed between the shoulders to extend the head upon the cervical spine. The back of the head is supported by a small soft pillow. The operating table is tilted so that the head-end of the table is raised slightly, in order to avoid any possibility of the head becoming dependent and the veins engorged; for this reason, also, hyperextension of the head must always be avoided. The surgeon, using a headlight, stands or sits above the patient's head.

Efficient suction, by means of a powerful electric pump, is indispensable. Only by this means can the field of operation be kept clear of blood, and the necessity for frequent swabbing avoided. Adequate suction not only reduces the operating time, but minimizes the risk of lung complications. Continuous suction is employed by means of two rubber catheters passed through the nostrils into the roof of the nasopharynx. Intermittent suction is also carried out by the assistant, who uses a long curved metal tube, passed through the mouth. The blood is collected into one reservoir and the volume is checked both during and after the operation.

Repair of the Palate.—The method of repairing the palate varies with the type of cleft to be closed. It is unwise to use one operative technique and apply it to all types.

During recent years, the great advances in the technique of cleft-palate surgery have been due mainly to the principles laid down by Victor Veau,[35] of Paris:—

1. An epithelial covering must be provided on the nasal as well as on the palatal side of the flaps.
2. Obliteration of dead space above the palatal flaps.
3. Avoidance of muscle injury, and union by suture of the separated palatal muscles.

The important principles of the modern operation are well established, but the method of cutting the buccal flaps remains controversial. The choice of the flap employed should depend on the type of cleft to be treated. The types of operation which seem most applicable to the various types of cleft which are commonly encountered may be summarized:—

A. Primary Cases.—

Group I: Complete cleft of hard and soft palate, in which there is little or no deficiency of the lateral elements (many cases of Veau Types III and IV)—*a modification of Axhausen's operation.*

Group II: Wide clefts of the palate in which there is also deficiency of the lateral elements (many cases of Veau Types I and II, and a few cases of Types III and IV)—*Wardill's operation* (V–Y elongation of the palate) with or without pharyngoplasty (depending upon the development of Passavant's cushion).

B. Secondary Cases.—Defects in the palate following previous unsuccessful operations.—

Group III: *Complete residual cleft* of hard and soft palate with (i) *moderate scarring—Wardill's operation* and pharyngoplasty; (ii) *severe scarring—Gillies-Fry operation* to repair soft palate.

Group IV: *Complete closure of cleft with gross shortening—'push-back operation'* (*Moorehead* or *Dorrance*) *with pharyngoplasty.*

Group V: *Residual cleft* of soft palate and posterior third of hard palate (or soft palate only)—*Wardill's operation with pharyngoplasty.*

Group VI: *Residual gaps in the palate*—treatment depends upon the size and position of the defect.

A. PRIMARY CASES

Group I—A Modified Axhausen Operation

1. Freshening the Borders of the Cleft.—

a. Paring the Edges of the Soft Palate.—The edge of the right segment of the soft palate is held in the teeth of a long pair of fine dissecting forceps. At about the middle of the soft palate the border is transfixed by a No. 11 Bard-Parker knife mounted upon a long handle. From this point the remaining edges of the soft palate are pared (*Fig.* 182).

The method used by some surgeons of incising, instead of excising, the edges of the soft palate, is not advisable, because each mucosal edge, being curved inwards, tends to invert when the sutures are tied.

Fig. 182.—Paring the edges of the soft palate.

Fig. 183.—Incising the medial border of the hard palate.

b. Incising the Medial Border of the Hard Palate.—An incision is made with a No. 15 Bard-Parker knife, parallel to the medial border of the hard palate, but some distance towards the buccal side of it. The line of incision corresponds to the junction of the mucosa belonging to the hard palate and the thinner and darker

coloured nasal mucosa, which covers the border of the cleft. This line of demarcation does not exist so clearly in cases that have been operated upon before, and in these cases it is better to excise a portion of the scar tissue from the edge.

Starting behind, at the anterior end of the wound made by paring the soft palate, the knife is inserted through the mucoperiosteum down to the bone, and then drawn carefully forwards to the anterior extremity of the cleft. (*Fig.* 183.)

Similar procedures are carried out upon the medial border of the left side of the cleft.

2. Elevation of Flaps of Nasal Mucosa to form the Floor of the Nose.— *a. In the region of the Hard Palate.*—The inner edge of the medial incision is elevated from the bone by means of a small curved dental elevator and drawn gently inwards with fine dissecting forceps. The mucosa is then carefully separated around the free inner border of the bone. This is the most delicate phase of the operation, and must be carried out deliberately, and without hurry, in order to avoid tearing the nasal mucosa. The field must be kept absolutely dry, and precise illumination of the scene of operation is essential. It is important to keep the free extremity of the elevator, which is not sharp, in close contact with the bone the whole time. The concavity of the elevator is held towards the bone.

After freeing the mucosa from the whole of the inner edge of the bone, a large spoon-shaped elevator is inserted, in order to complete the mobilization of the mucosa from the floor and side of the nose (*Fig.* 184).

FIG. 184.—Mobilization of the nasal mucosa.

FIG. 185.—Division of fibrous band

The lateral nasal flap is freed from the anterior extremity of the cleft and backwards as far as the junction of the hard and soft palate.

From each half of the posterior nasal spine there is a small fibromuscular band which is continuous with the azygos uvulæ muscle behind, and merges into the palatine aponeurosis on the outer side. The band fixes the flap of nasal mucosa firmly at this point, and must be divided. The flap is drawn gently inwards, putting the fibrous band on the stretch. The band is then divided with scissors or a special hooked knife (*Fig.* 185).

In many cases it is simpler to divide the base of the posterior nasal spine with the band attached to it. The inner half of the palatine aponeurosis is then separated from the posterior free border of the bony palate by curved scissors or a dental

scaler, being careful during this process not to injure the nasal mucosa, which lies above it.

b. In the region of the Soft Palate.—The wound, which was made when paring the medial border of the soft palate, is widened by undercutting the buccal and nasal mucosa and separating the muscles of the soft palate into an intermediate layer.

On the opposite side, a slightly modified procedure is carried out (*Fig.* 186).

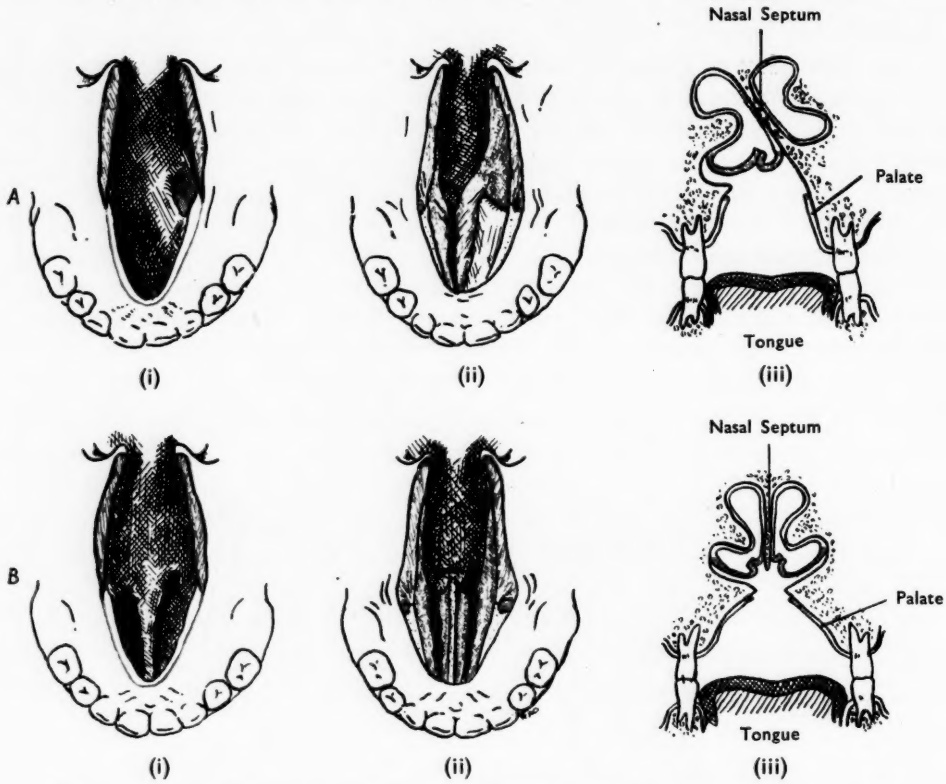

FIG. 186.—Elevation of flaps of nasal mucosa to form the floor of the nose. *A*, (i) Unilateral cleft, (ii) Flap mobilized, (iii) Coronal section; *B*, (i) Bilateral cleft, (ii) Flap mobilized, (iii) Coronal section.

In unilateral clefts, the other nasal flap is taken from the septum which ascends obliquely from the cleft towards the opposite side of the nose. This mucosa separates easily, except near the posterior extremity of the septum.

In bilateral clefts, in which the nasal septum is merely suspended from above, and is not attached to either side, a longitudinal incision is made along the inferior free border of the septum. A flap is taken from each side of the septum and sutured to the corresponding lateral nasal flap.

3. Lateral Relaxation Incision.—An incision is made with a No. 15 Bard-Parker knife along a line which runs near the inner border of the teeth and extends forwards almost to the anterior extremity of the cleft. It is prolonged backwards and laterally behind the last molar tooth for about half an inch along the line of the pterygo-mandibular raphe.

a. Elevation of Hard Palate Mucosa.—A straight elevator is inserted into the anterior part of the lateral incision and the mucosa is elevated from the bone to

form the outer two-thirds of the lateral buccal flap. The inner third is elevated by means of a curved elevator inserted under the inner edge of the medial incision, made previously when freshening the borders of the cleft.

b. Mobilization of Soft Palate and Division of the Hamulus.—The posterior part of the lateral relaxation incision is made to gape by inserting a curved cheek retractor through the angle of the mouth. The wound is deepened in the line of the pterygo-mandibular raphe by pressing the buccinator outwards and the superior constrictor muscle inwards, using a straight blunt elevator. The areolar tissue is separated and then the glistening tendon of origin of the internal pterygoid is seen. It is important to avoid going too far laterally otherwise the loose fatty tissue of the sucking-pad will project awkwardly into the wound.

The position and size of the hamulus is variable and the origin of the internal pterygoid must be clearly seen, as it is the best guide to the hamulus. A straight elevator is passed along the inner side of the internal pterygoid and the soft tissues are pushed inwards until the hamulus is at first felt and then seen. If there is any difficulty a little finger inserted into the wound will soon identify it. The base of the hamulus is fractured by leverage inwards with the elevator or the base may be cut by a strong pair of ' curved-on-flat ' scissors.

c. Lateral Pharyngeal Mobilization.—On the medial side of the internal pterygoid muscle there is a fascial space which surrounds the pharynx. The upper and palatal fibres of the superior constrictor, the muscles of the soft palate, and the pillars of the fauces all lie on its inner wall. The internal pterygoid lies on the outer wall. The levator palati crosses the space in the depths of the wound, and, as the levator is rarely seen, care must be taken not to damage it by forcible retraction. Whillis has shown that this space has no communication with the mediastinum, and, if infection occurs here, it tends to come to the surface behind the angle of the jaw. Dissection in this fascial space, first with a straight blunt elevator, and then with a finger, serves to mobilize the soft palate without compromising its muscular action.

The lateral half of the palatine aponeurosis is dissected free from its attachment to the posterior border of the hard palate by means of a sharp dental scaler or ' bent-on-flat ' scissors. Again, it is important to avoid injury to the mucosa on the nasal surface of the soft palate, which lies deep to the palatine aponeurosis. The posterior palatine vessels are divided in most cases to ensure adequate lateral relaxation; if hæmorrhage is free, gauze packing is inserted temporarily.

A similar procedure is undertaken through the other lateral relaxation incision.

If the previous steps in the operation have been carefully performed, in most cases the flaps can be drawn inwards to the middle line, so that they meet easily. Should there be tension, further lateral relaxation is required before suturing can be undertaken safely. If it is found at this stage that, despite further lateral relaxation, there is still some tension, elongation and inward rotation of the flaps is advisable. A transverse incision is made across the nasal flaps above the bony palate and an oblique incision is made across the buccal flaps, so that a V–Y elongation (cf. Wardill,[37] 1937) can be effected, not only of the buccal, but also of the nasal mucosa.

4. Suturing.—We use a special fully-curved cleft-palate needle, mounted on a fine straight Mayo's needle-holder or occasionally a Collin or Jalaguier type of fine Reverdin needle. Needle-holders with elaborate curves and catches are

unwieldy and unnecessary. The secret of suturing in a confined space, long ago revealed by Moynihan and more recently applied to cleft-palate surgery by Denis Browne,[10] is the use of a fully-curved needle (*Fig.* 187).

a. Nasal Mucosa.—Using fine chromic catgut the first stitches are inserted into the nasal mucosa near the anterior extremity of the cleft. The edges of the nasal mucosa are seen more easily if the assistant draws the inner borders of the buccal flaps outwards by means of two fine hooks. It is important to invert the nasal mucosa so that the edges project upwards when the stitches are tied. If 'loop-on-mucosa' stitches can be inserted, these are ideal for this purpose. (*Fig.* 188.)

FIG. 187.—Author's cleft-palate needle (actual size), $\frac{11}{16}$ circle bend; length, $\frac{5}{8}$ in., diameter $\frac{3}{4}$ in., with round body and short triangular point (made by Messrs. Chas. F. Thackray, Ltd., Park Street, Leeds).

The uvula is sutured with 6/0 catgut mounted upon a No. 6 eye-curved eyeless needle. The tip of the uvula is repaired very carefully and then drawn forwards, so that further stitches may be inserted into the posterior and upper aspect of the soft palate.

b. The Muscles of the Soft Palate are united with three catgut stitches, which do not include the mucosa on either surface of the palate (*Fig.* 189).

c. Buccal Mucosa.—In the region of the soft palate, the mucosa is sutured with 'end-on mattress' sutures, using fine silkworm-gut on an eyeless needle.

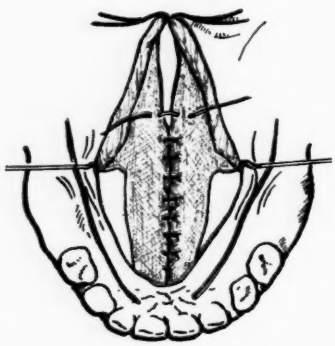

FIG. 188.—Suturing nasal mucosa.

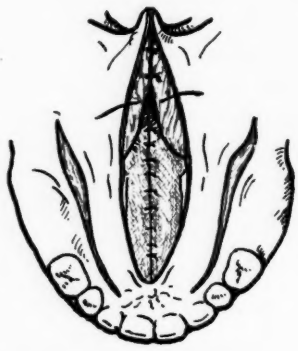

FIG. 189.—Suturing the muscles of the soft palate.

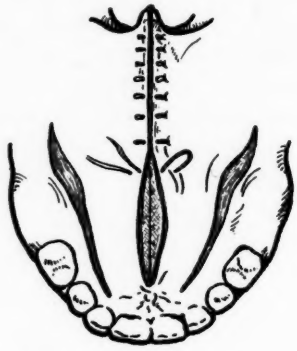

FIG. 190.—Suturing the bucca mucosa.

When suturing the stronger mucosa overlying the hard palate, stouter silkworm-gut is used, threaded on a spear-pointed needle (*Fig.* 190).

At the end of the operation a catgut stitch is inserted into the tip of the tongue so that it can easily be drawn forwards if it occludes the airway before the patient has recovered from the anæsthetic.

GROUP II—WIDE CLEFTS OF THE PALATE IN WHICH THERE IS ALSO DEFICIENCY OF THE LATERAL ELEMENTS

In this group are placed primary cases in which the cleft is wide and the lateral elements are unnaturally short; this includes many cases of Veau Types I and II and some cases of Types III and IV. A method of elongating the soft palate and narrowing the nasopharyngeal isthmus is required. Wardill's operation[37] for repairing the palate by a V–Y elongation of the mucosa, associated with

pharyngoplasty, is the best method of treatment (*see Brit. Jour. Surg.*, 1937, **25**, 117, for the details of the technique) (*Fig.* 191).

FIG. 191.—Wardill's operation for repair of the palate by V–Y elongation of the buccal mucosa (*after Wardill*).

B. SECONDARY CASES—DEFECTS IN THE PALATE FOLLOWING PREVIOUS UNSUCCESSFUL OPERATIONS

GROUP III—COMPLETE RESIDUAL CLEFT OF HARD AND SOFT PALATE

The method of treating these cases depends upon the amount of tissue available and the degree of scarring which is present.

1. Moderate Scarring.—If the tissue remaining is adequate, it is feasible to repair both the hard and the soft palate. As there is usually definite shortening, due to contracture of the scar tissues, some method of elongating the palate is required, and Wardill's pharyngoplasty, associated with his V–Y elongation of the palate, is again indicated.

2. Severe Scarring.—If, after the original operation there has been extensive sloughing of the lateral flaps, it is wise to repair only the soft palate on the principle of a Gillies-Fry[40] operation (*Fig.* 192). A long mobile soft palate is fashioned

FIG. 192.—Repair of the soft palate by a modified Gillies-Fry operation.

from the available tissue, and the defect in the hard palate is occluded later by an obturator. It is extremely bad surgery to attempt closure of both the hard and the soft palate in this type of case if there is a possibility of obtaining complete closure at the expense of the length and mobility of the soft palate. A soft palate which is short and immobile is useless.

Group IV—Complete Closure of Cleft with Gross Shortening and Immobility of the Soft Palate

In these cases, it is again wise to remodel the soft palate at the expense of the hard palate. After performing a Wardill pharyngoplasty, the mucosa of the hard palate is freed completely in front, and the palatal tissues are displaced backwards.

In the less severe cases an 'M' incision is made in the buccal mucosa over the hard palate, and a central V–Y elongation carried out (Moorehead,[41] 1928) (*Fig.* 193).

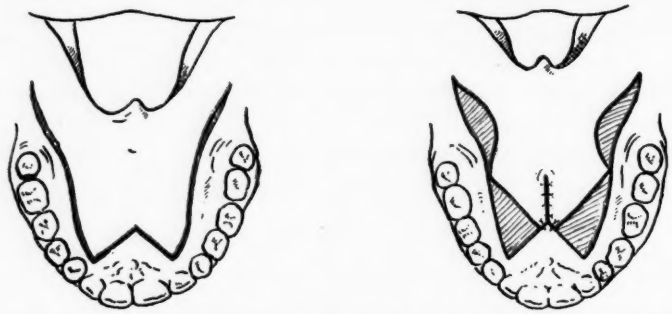

Fig. 193.—Method of elongating a shortened palate by 'M' incision (*Moorehead*).

In severe cases, a U-shaped flap is formed (Dorrance,[42] 1933). The whole of the palatal tissues are separated from the underlying bone, including the posterior edges of the hard palate, and then displaced backwards. (*Fig.* 194.)

Although a large gap is often left in front, an efficient soft palate can thus be formed.

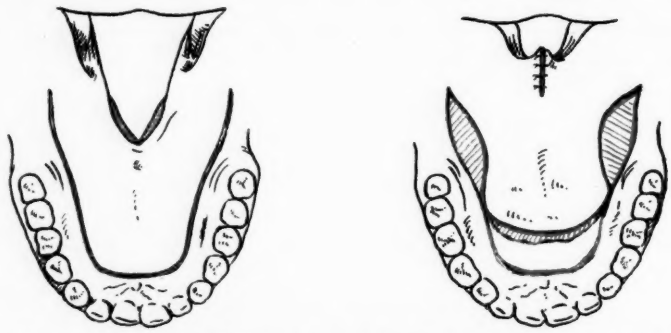

Fig. 194.—Method of fashioning a mobile soft palate at the expense of the hard palate by 'U' incision (*Dorrance*).

Group V—Residual Cleft of the Soft Palate and Posterior Third of the Hard Palate

Wardill's pharyngoplasty and V–Y elongation of the palate are indicated.

Group VI—Residual Gaps in the Palate

1. Wide Gap near the Junction of the Hard and Soft Palate.—This is a fairly common type of secondary deformity requiring operative treatment. If there has not been a severe loss of tissue due to sloughing, it is usually possible to remedy the defect by making long lateral incisions. The hamular processes are fractured

on each side, and thorough lateral pharyngeal relaxation effected. The edges of the defect are excised and the buccal and nasal mucosa are separated into two layers by undercutting, and then sutured independently.

If, however, there has been serious loss of mucosa by sloughing of one or both of the lateral flaps in this region, mucosa may be obtained from the inner side of the cheek (Padgett,[43] 1936). As there is in normal conditions but little muscular tissue in this part of the palate, an inert but mobile partition is all that is required.

When the nasal mucosa is deficient the cheek flap is cut so that the lateral incision, outlining the flap, extends farther back than the medial incision. The cheek flap is rotated so that it lies on the nasal side of the buccal flaps, and is fixed by mattress sutures to the edge of the opposite lateral relaxation incision. The raw surface of the cheek flap lies in contact with the raw upper surface of the buccal flaps and the mucosa from the cheek replaces the nasal mucosa. (*Fig.* 195.)

FIG. 195.—Rotation of a cheek flap to replace nasal mucosa.

When there has been severe loss of buccal mucosa, the medial incision, made to outline the cheek flap, extends farther back than the lateral incision. The cheek flap is rotated with its raw surface towards the nose. The upper surface of the palate is formed by flaps of mucosa which are elevated from the edges of the defect. They are left hinged upon the nasal mucosa and are closed inwards like swing-doors and fastened by stitches in the midline.

2. Wide Gap in the Middle of the Hard Palate.—These defects can be closed by a minor operation. The alternative method of treatment, by means of an obturator, successfully occludes the aperture, but the obturator is often uncomfortable, usually expensive, and requires frequent readjustment, especially in children.

Long lateral relaxation incisions are made parallel to the defect on each side of the hard palate. ' Swing-door flaps ' are raised from the edges of the cleft and turned inwards and upwards towards the nose; these flaps are sutured with catgut, their free margins being inverted towards the nose. Lateral ' bridge-flaps ' of buccal mucosa are made to slide inwards below these, and are united with ' end-on mattress ' sutures of silkworm-gut.

3. Wide Gap in the Anterior Third of the Hard Palate.—If the defect is so large that air and food leak into the nose through it, a similar operation to that for repair of a defect in the middle of the hard palate is performed, except that the buccal flaps are detached in front and then rotated inwards. They are prevented from curling back by a mattress suture which is passed from their anterior extremities into the mucosa behind the upper alveolus.

4. Small Holes in the Hard Palate.—These usually close spontaneously, sometimes as long as two years after the original operation. Cauterization with a stick of silver nitrate stimulates the process of closure. Operation is not necessary.

5. Gap in the Alveolus, extending into the Anterior Third of the Palate and the Base of the Nostril.—These cases are associated with a hare-lip deformity. Often there is flattening of the lip and a prosthesis will be required to hold the lip forward after an epithelial inlay has been performed. There is no object in performing an operation to close the defect, because the prosthesis will cover it.

6. The Most Severe Residual Clefts, in which both Lateral Flaps have sloughed extensively.—A wide gap remains, without enough soft tissue in the roof of the mouth even to repair the soft palate. In these cases an obturator should be advised. Operative treatment is unsatisfactory.

Padgett[43] and Axhausen[9] have used extra-oral tissue introduced into the mouth by means of a tubed-pedicle graft from the upper arm or front of the chest. These fantastic operations are only possible in an adult. The pain and discomfort of the patient during the various stages and the flaccid immobility of the fictitious palate, which has no musculature whatsoever, outweigh any disadvantages which an obturator undoubtedly possesses. Such operations are feats of surgical madness in its most despicable form.

POST-OPERATIVE TREATMENT

A considerable degree of post-operative shock may be encountered in the fragile type of infant upon whom a fairly extensive operation has to be performed. If the mortality, in a considerable number of cases, is to be kept within reasonable limits, special precautions against shock must be taken as a part of the ordinary routine of operation.

It is advisable that certain of the more fragile children should receive a continuous intravenous drip infusion for the first twenty-four hours after operation. If this after-treatment is used the condition of the patient is never a cause of anxiety during the first twenty-four hours. The child rests quietly and the pulse remains strong. No disturbance for the administration of fluids by mouth or rectum is required.

If the apparatus is prepared as a routine beforehand, it is a matter of less than five minutes' work to insert a ureteric catheter or small gold cannula into the long saphenous vein as it passes anterior to the medial malleolus. No matter how young the patient, the vein in this situation is always large enough and can easily be found. If a ureteric catheter is properly inserted, and a length of spare catheter left coiled in the bed, the child need not be restrained and it may kick to its heart's content without danger of the tube being kinked or the catheter dislodged. (*Fig.* 196.)

This procedure is undertaken, in ideal conditions, by the assistant, whilst the surgeon is inserting the stitches in the buccal mucosa. The patient returns to the ward with 5 per cent glucose in normal saline running into the vein at the rate of

between 30 and 50 drops per minute. It continues running at 30 drops per minute for the first twenty-four hours. After this time the child has recovered from the immediate effects of the operation and can take fluids liberally by the mouth.

In the case of an especially fragile or anæmic child a transfusion of about 10 oz. of citrated blood is given *slowly* by a Vacoliter drip apparatus during the first night following the operation. Glucose saline is administered for the next twelve to twenty-four hours. Not only does this prevent shock and restore the volume of the circulation, but it has been found that convalescence is more rapid if the blood lost at the time of operation is replaced at once. The avoidance of a week of relative anæmia, which would otherwise follow the operation, also helps the local condition of the flaps. The collateral anastomosis is established more rapidly and the incidence of sloughing of the flaps is reduced considerably. It is, however, most important to remember that blood or saline when administered intravenously

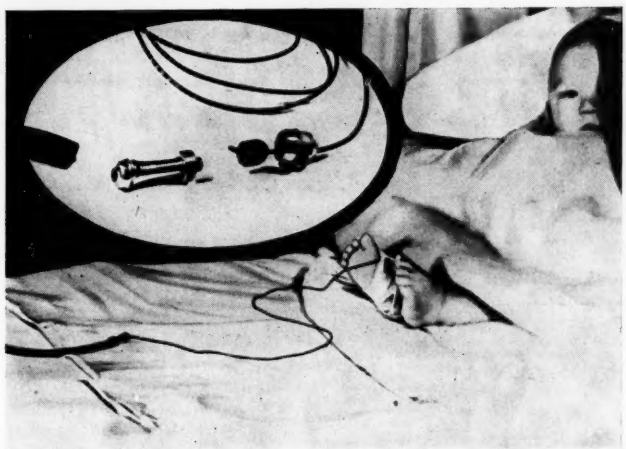

FIG. 196.—Photograph showing a ureteric catheter in use for drip transfusion and infusion. The inset shows the connector from the rubber tubing to the ureteric catheter.

to an infant or young child must always be given *slowly by drip infusion.* The injection of blood or saline by means of a syringe is particularly dangerous in a young child.

The child's head is kept flat for the first four hours after operation, and then he is gradually propped up, one pillow at a time, until after twelve hours he is in Fowler's position. If the child is fretful and thirsty, glucose water and orange juice may be given by the mouth as soon as he has become conscious.

After forty-eight hours, soft foods, such as jelly, chicken broth, gravy and mashed potatoes, and mashed bananas are given. Milk or hard food is strictly avoided. Water is given at the end of each feed to rinse out the mouth, but in older children frequent mouth-washing is also advisable. On no account must any swabbing or spraying of the inside of the mouth be allowed after operation. It is wise not to disturb the child to look inside the mouth until the fourth or fifth day. The patient should not be allowed to see the mother until after the palate has healed; on rare occasions, however, this is impossible to arrange, and then the mother must live in the room with the child and be with him the whole time. Occasional visits are disastrous.

When the palate has been repaired, only the first stage of the treatment has been completed. The main disability is the defect in speech. It is therefore imperative for the surgeon who has undertaken the treatment of one of these cases to supervise the after-care. The patient must be seen at regular intervals, as an out-patient, until speech has been restored. The help of a fully-qualified and enthusiastic speech trainer is of inestimable value.*

PROGNOSIS

When a cleft-palate patient is brought to see a surgeon, the parents often ask, "What are the prospects of speech being improved?" or, "Will my child have normal speech after the operation?"

Accurate prognosis is notoriously difficult, but some of the important factors to consider in estimating a prognosis may be tabulated:—

Bad	*Fair*	*Excellent*
Speech unintelligible, or difficult for strangers to understand	Improvement in speech, but rarely perfection	Normal speech or speech that is not noticeably abnormal
1. *Mental deficiency*	1. *Over 3 years of age* the patient is old enough to have acquired bad habits of speech before operation	1. *Under 2 years of age*
2. *Deafness*, if serious or complete	2. *Failure of previous operative treatment*	2. *No previous operation* on the palate
3. *Congenital heart disease* if uncompensated and the patient is unfit for surgical treatment	3. *Partial deafness*	3. *A sensible mother*
	4. *An indifferent mother*	4. *Speech training* facilities available
	5. *A mother with an untreated cleft palate* and having the associated defects in speech	

Nevertheless it is unwise and even dishonest to give a detailed prognosis. There are many factors which are not directly under the control of the surgeon; for example, it is well known to every one who treats cleft-palate cases that occasionally paradoxical results occur. Despite every apparent care some patients with perfect anatomical palates and competent nasopharyngeal valves never acquire perfect speech. Other patients with short soft palates and deficiencies in the hard palate speak extraordinarily well. Veau,[44] and Wardill[6], [45] as well as many other cleft-palate surgeons, have described such cases. Veau believes that extraordinary activity of the levator palati and superior constrictor is acquired and the soft palate can be arched to such an extent that its upper surface can still be brought into contact with the posterior wall of the nasopharynx. He also described cases with stiff and short soft palates in which nasopharyngeal occlusion took place owing to the presence of a short sagittal development of the nasopharynx and in some cases the adenoids were so large that they completed the occlusion.

* It is recognized that this discourse is necessarily incomplete without reference to the physiology of speech and the methods of speech training. These are to form the subjects of a future communication.

At a Hunterian Lecture in 1928, Wardill[6] discussed the unsatisfactory results of cleft-palate operations at that time. He said, " What, then, can surgery offer to the sufferer from cleft palate ? The answer is about a ten-to-one chance against his ever becoming a normal speaker ". Since that time, mainly owing to the research and untiring activity of Wardill himself, the prognosis has improved considerably.

RESULTS

An analysis has been made of 120 consecutive cases which have been treated during the last six years. Repair of the palate by operation was denied to 4 cases only, 3 upon the grounds of mental deficiency and 1 owing to the presence of an uncompensated congenital heart lesion. Of the 116 cases operated upon, 88 (75 per cent) cases were primary and 28 (25 per cent) were secondary, the latter having had previous unsuccessful operations elsewhere. Of the 88 primary cases, 10 were Veau Type I, 28 Type II, 44 Type III, and 6 Type IV.

There have been 3 deaths following operative treatment in the 116 cases, a mortality of 2·6 per cent.

1. Speech Results.—An attempt has been made to analyse the speech results of the cases treated. This investigation has been interrupted by the national scheme for the evacuation of school children.

In the examination of the cases which were reviewed, the patient was asked to articulate the consonant sounds, which often cause difficulty when the palate has been cleft. The vowel sounds ' oo ' and ' ee ' were tested. The results have been tabulated on a chess-board type of case card. Nasal tone, huskiness of the voice, and the general character of the articulation were estimated, following conversation with the patient, and the impression obtained was recorded in a separate column.

Favourable speech results were noted in 86·3 per cent of the cases examined and unfavourable results in 13·7 per cent. They were classified in three groups :—

a. Excellent—32 *Cases.*—Patients from whose speech it was impossible to detect that a cleft palate had ever been present.

b. Good—31 *Cases.*—Patients whose speech was greatly improved, and who could speak so clearly that even strangers could easily understand them. On careful investigation it was found that even though some of these patients could pronounce all the individual consonant sounds correctly, they still betrayed evidence of nasal intonation or huskiness of the voice when excited or talking fast. In some of the cases, the sibilant sounds, although pronounced, were imperfect.

c. Bad—10 *Cases.*—Patients whose speech had all the typical cleft-palate characteristics and who were difficult for strangers to understand.

2. Anatomical Results.—The anatomical results are given in the 113 surviving cases which were treated by operation, but these results are considered to be of secondary importance in comparison with the speech, and they may be summarized briefly.

Complete Closure of Hard and Soft Palate	*Partial Closure with Obturator to cover Defect in Hard Palate*	*Non-union*
96	12	5

In the 108 cases in which the palate was repaired :—

Soft Palate Long and Mobile	*Soft Palate Stiff and Short*
86	22

Numerous methods have been devised for testing the efficiency of the naso-pharyngeal valve. Not one of these, when applied singly, is perfectly reliable. It is always necessary to apply two, or possibly three, of the tests before the function of the valve can be gauged at all accurately. Wardill,[45] Kilner,[38] and Dorrance[42] have described the various tests that have been used to estimate the competence of the nasopharyngeal valve :—

a. Snorting Test.—An ' impolite ' noise can be produced if the patient sucks air suddenly into the nose while the tongue is protruded.

b. Carnival Blower Test.—Carnival blowers and rubber balloons can be blown up without difficulty.

c. Match Test.—A lighted match can be blown out even when held at some distance from the patient's mouth.

d. Mirror Test.—A cold mirror, held in front of the patient's nose, is not steamed when the patient says ' Ah '.

e. Cotton-wool Test.—A wisp of cotton-wool, held in front of the patient's nose, is not swayed by the escape of air when an oral consonant is pronounced.

f. Spirometer Test.—This is a scientific test devised by Wardill for estimating the relative volumes of air escaping from the nose and mouth. By the use of tubes fitting tightly into each nostril and the mouth, the air is collected in bags and the volumes measured. This test is, however, rather too complicated for everyday use, and we have found the first two tests to be the most useful in practice.

Nasopharyngeal valve in 87 cases tested :—

Competent	*Partial Competence*	*Incompetent*
59	14	14

DISCUSSION

Great progress in the operative treatment of cleft palate has taken place in recent years, and is due mainly to the wise precepts of Veau[35] and Wardill[6, 18, 37]. Previous to their work the Langenbeck operation was the standard method and the results were most unsatisfactory. Non-union occurred in a high percentage of cases, and, when the palate was united, it was usually stiff, short, and immobile. The nasopharyngeal sphincter was incompetent in nearly all cases.

Veau showed the importance of repairing the nasal mucosa and the muscles of the soft palate, as well as the buccal mucosa. He emphasized the necessity for obliterating the dead space above the palatal flaps. His sound logic was backed by his own results in over 1000 cases.

The outstanding points of controversy in the treatment of cleft palate at the present time are :—

1. The necessity for separating the buccal flaps from their anterior attachments in all cases.
2. The value of wide mobilization of the lateral pharyngeal wall.
3. The necessity for dividing the posterior palatine arteries.
4. The methods of narrowing the nasopharyngeal isthmus and the advisability of routine pharyngoplasty.

The controversy between the French school led by Veau[35] and the German school led by Axhausen[9] is waged about the so-called ' bridge-flap '. Some of the most experienced cleft-palate surgeons in England, such as Wardill and Pomfret

Kilner, have followed the French school, and always divide the buccal flaps from their anterior attachments. Veau used a long flap hinged upon an intact posterior palatine artery. The classical technique of his operation has been modified by other surgeons. Dorrance[42] modified the procedure by performing a two-stage operation and making a U-shaped buccal flap. Wardill[37] emphasized the importance of dividing the posterior palatine arteries and, therefore, of having a shorter posterior flap. He uses four buccal flaps, sutured in such a way that a "V–Y elongation" of the *buccal* mucosa is effected. Although the junction of the four flaps is a potential site of insecurity, this method of elongating the palate is the most valuable yet described.

Kilner, McIndoe,[46] and Mowlem,[46] as well as elongating the buccal mucosa, make a transverse incision in the anterior part of the nasal mucosa above the bony palate, and in this way manage to elongate the nasal flaps. They have also demonstrated the value of a preliminary injection of local anæsthetic solution into the tissues to reduce hæmorrhage.

Axhausen,[9] Denis Browne,[90] Vilray P. Blair, and J. B. Brown[39] believe that it is possible to fulfil all the requirements of the Veau principle without separating the buccal flaps in front in every case. A modified 'bridge-flap' which is adherent to the dome of the palate is still used in their operations.

The solution of the problem appears to be that *the method of fashioning the buccal flaps depends upon the type of defect to be closed.* In cases in which there is a primary deficiency of the soft tissue or a secondary shortening of the palate due to contracture of scar tissue, some method of elongation is necessary. Then the buccal flaps must be separated completely in front and lengthened by the Veau or Wardill technique. If, on the other hand, the soft tissues of the lateral elements are not deficient and are adequate in length it is unnecessary to separate the buccal flaps in front. If lateral relaxation has been complete, it is found that there is abundant tissue to form a long palate. Axhausen's[9] technique and his results in 100 cases with the modern 'bridge-flap' operation, which fulfils Veau's three essential principles, is worthy of note. But the employment of a prosthesis to hold the buccal flaps upwards against the dome of the bony palate complicates the technique unnecessarily, and is conducive to sepsis and pressure necrosis.

Thorough lateral relaxation has been an accepted principle since the teaching of Fergusson[11] (1845) and Liston[4] (1846). Any lateral tension upon the suture line spells disaster. It is advisable in all cases to fracture the hamular processes in order to mobilize the tensor palati (Billroth,[5] 1889). The extensive lateral pharyngeal mobilization as practised by Ernst,[47] is useful in the secondary cases in which there has been much scarring and shrinkage of the lateral elements of the soft palate. Ernst's practice of packing iodoform gauze outside the lateral wall, after pharyngeal mobilization, is unnecessary and dangerous, because the gauze soon becomes most foul and may cause serious septic complications.

It is essential in the majority of cases to divide the posterior palatine arteries to secure adequate lateral relaxation, but in a few cases, if the flaps are free enough without its division, the artery can be spared.

So long as the Veau principles are followed in each case, if lateral tension is relieved, the nasal mucosa mobilized and sutured, the muscles of the soft palate repaired, the type of buccal flap employed should vary with the type of cleft to be treated.

METHODS OF NARROWING THE NASOPHARYNGEAL ISTHMUS

Although for many years surgeons have expressed the most divergent views about the method of repairing a cleft palate, all agree that efficient closure of the nasopharyngeal isthmus is essential for attractive speech.

Since the work of Gustav Passavant[15, 48, 49] in 1862, various methods of occluding the isthmus have been devised. The most important may be described concisely in three groups: (1) Suture of the posterior pillars of the fauces; (2) Union of the soft palate to the posterior pharyngeal wall; (3) Plastic operations upon the posterior pharyngeal wall.

1. Suture of the Posterior Pillars of the Fauces.—Passavant[49] was the first to describe this procedure in order to prolong the soft palate backwards towards the posterior pharyngeal wall. Since that time it has been employed by Brophy,[50] Wardill,[18] Blair, Brown,[39] and Padgett.[43] From their results, it would appear that this procedure has a limited place in cleft-palate surgery, and is only indicated in certain secondary cases, for elongating a shortened soft palate.

2. Union of the Soft Palate to the Posterior Pharyngeal Wall.—Passavant[48] described a method of detaching the soft from the hard palate, and, after sliding the soft palate backwards, he sutured the uvula to the posterior pharyngeal wall. Schoenborn[51] raised a rectangular flap from the posterior wall of the pharynx and sutured it into the defect in the soft palate. This procedure was revived by Rosenthal[52] in 1924 and more recently by Padgett[43] in 1936. We have never used this method because it appears to cause a most artificial occlusion of the nasopharynx which would interfere seriously with the elevation of the soft palate.

3. Plastic Operations upon the Posterior Pharyngeal Wall.—In 1876, Rutenberg[53] described an operation for narrowing the nasopharyngeal orifice in order to improve speech; he advised its use in cases in which the soft palate was shortened following repair of the palate. He suggested that a transverse incision should be made across the posterior pharyngeal wall extending outwards along the lateral walls to the hamulus on each side. The incision, when completed, was semicircular, with its convexity directed slightly downwards, and placed at the level of Passavant's ridge. The incision extended through the mucosa, but not the muscle, and could be made with knife or cautery. The defect was sutured longitudinally so that the pharynx could be narrowed like the vaginal orifice after a colporrhaphy. No reference was made to the functional results obtained by this operation.

In 1878 Passavant[49] raised a rectangular flap of mucosa from the posterior pharyngeal wall. The flap, still attached by a pedicle below, was then folded upon itself and sutured so that a shelf-like projection was made upon the pharyngeal wall. After a short time the shelf disappeared, and the operation was abandoned.

In 1907 Botey[54] advised excision of one, or sometimes two, elliptical areas of pharyngeal mucosa. The axis of the excised area was vertical. After mobilisation the lateral edges of the defect were sutured in the midline, in order to narrow the pharynx.

At the Royal Society of Medicine in 1927 and at Hunterian Lectures in 1928 and 1933, Wardill[45, 6, 18] described the operation of pharyngoplasty, which was similar in principle to the Heinecke and Mikulicz pyloroplasty,[55] except that it was reversed, being designed to narrow and not to widen the channel. Briefly, a transverse incision is made in the posterior pharyngeal wall at the level of the transverse

arch of the atlas ; it passes through the mucosa and superficial fibres of the superior constrictor, but not through the buccopharyngeal fascia. After peeling the constrictor muscle from the surface of this fascia by means of a blunt elevator, the wound is sutured in a vertical direction, taking a firm bite of the tissues and including the salpingopharyngeal folds in the stitches. Unlike most of the previous operations devised for narrowing the nasopharyngeal isthmus, this operation is based upon sound physiological principles and " has for its object the imitation and exaggeration of the normal method of palatopharyngeal closure—that is, an artificial but greatly exaggerated, cushion of Passavant is created on the posterior pharyngeal wall ".

In 1935, Denis Browne[10] described a process of pharyngoplication by means of a ring suture. Using a special fully-curved needle, a purse-string is passed from each lateral relaxation incision behind the posterior pharyngeal wall at the level of the ridge of Passavant. The ring is completed by passing the stitch through the substance of the soft palate. The suture is tied after completion of the operation for the repair of the palate. To have any effect, the suture must be tight. Catgut stitches tied under tension in any surgical procedure, but especially in the repair of a cleft palate, soon tear through the tissues, or break. This ingenious stitch was devised by Denis Browne to relieve tension on the sutures in the palate and also to maintain the nasopharyngeal sphincter in a relaxed position during the healing process. In our limited experience, the plicating effect on the pharynx of the purse-string seems to disappear soon after the operation. It seems doubtful whether there is enough time for the nasopharyngeal sphincter to have contracted adequately before the effect of the purse-string disappears.

When it is necessary to narrow the pharynx we have found that the Wardill pharyngoplasty is the most satisfactory and reliable procedure so far devised. There is no doubt that considerable and permanent narrowing of the isthmus is effected in a high percentage of cases. A fixed transverse buttress of inert fibrous tissue is formed across the posterior wall of the pharynx ; it acts, as Wardill[6] says, as a " valve seating for the upper surface of the soft palate ". Mechanically this arrangement seems to act fairly satisfactorily, but it does not restore the exact physiological mechanism of the nasopharyngeal sphincter, which is composed of actively contracting muscular slings. The levator sling arches the middle third of the soft palate upwards and backwards against an inert fibrous shelf instead of a curved and active muscular ring.

For this reason, in a case in which the sphincteric fibres of the superior constrictor are well developed and can be seen to produce a distinct and actively mobile cushion of Passavant, it may be unwise to interfere with this activity. During pharyngoplasty the separation and elevation of the valuable ring fibres of the constrictor must compromise their action. Moreover the scar tissue which is formed, following the inevitable infection of the pharyngeal wound, leads to fibrosis with resulting atrophy and fixity of these muscle-fibres.

After due consideration, we have found that it is not advisable to perform a pharyngoplasty *as a routine* in all operations for the primary repair of a cleft palate ; also it must be recognized that it does add considerably to the operative risks, especially in patients under one and a half years old. Nevertheless, Wardill's pharyngoplasty is firmly established as the most important supplementary procedure for narrowing the nasopharyngeal isthmus. We believe that it should only be done when special indications are present and then usually at the same time as the repair

of the palate. For instance, it is extremely useful when repairing certain primary cases of Veau Types I and II, when there is deficiency of the lateral elements, a poorly developed Passavant's cushion, and when it seems probable that the new soft palate will not be long or active enough to occlude the nasopharyngeal isthmus. We have found, however, that pharyngoplasty is most useful in the secondary cases in which there is gross scarring of the soft palate and incompetence of the nasopharyngeal valve. The association of pharyngoplasty with mobilisation and elongation of the soft palate in these difficult cases, has proved to be of inestimable value.

CONCLUSION

The treatment of cleft palate is a special branch of surgery. Cases should be segregated in each district, as in Finland, and treated by one surgical unit.

In order to avoid all tension on the sutures, it is necessary to obtain wide lateral relaxation and to fracture the hamular processes. The elevation and suturing of the nasal mucosa, as well as the muscles of the soft palate, is imperative. The method of fashioning the buccal flaps should vary with the type of cleft. Wardill's technique for pharyngoplasty is the best method so far devised, it results in a transverse bar of inert fibrous tissue which assists passively in the occlusion of the nasopharynx. It is not advisable, as a routine in all cases, especially in those in which a well-marked and actively moving Passavant's cushion is present before operation.

There is no shadow of doubt that in the unfortunate cases which are seen for the first time and treated after speech has developed, speech training is absolutely essential for any satisfactory functional result. We believe that speech training benefits nearly all types of cleft-palate case and should be advised as a routine after repair of the palate.

SUMMARY

A short description is given of the anatomy of the palate and nasopharyngeal sphincter. It is suggested that malnutrition of the mother is one important aetiological factor in cleft palate. The treatment of cleft palate is discussed and the principles of Veau and Wardill whole-heartedly endorsed, although it is believed that it is not necessary to separate the buccal mucosa from its anterior attachments in every case. A modification of Axhausen's technique is described in detail. The treatment of secondary cases is also described and the methods of narrowing the nasopharyngeal isthmus are discussed.

The results in a short consecutive series of 120 cases are analysed.

I should like to express thanks to my colleagues on the staff of the General Infirmary at Leeds and also to Sir Harold Gillies for inviting me to treat cases of cleft palate under their care. I am indebted to Mr. W. E. M. Wardill and Mr. Pomfret Kilner for their advice and criticism.

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CARCINOMA OF THE COLON IN CHILDREN
WITH REPORT OF A CASE

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JUVENILE cancer of the bowel is a rare condition, hence it is curious to note that Ewing[4] (1928) described it as "rather frequently" observed at an early period, and quoted several cases. A careful study of the literature between the years 1897 and 1940 has brought to light some 15 cases occurring in children. The eldest of these, described by Watts[16] (1927), was a girl of 18 who survived operation for five hours; the youngest a girl of 7, described by Pfeiffer and Wood[9] (1935). In Pfeiffer and Wood's description the site was given as the transverse colon and the type of growth as "fibroma with adenocarcinomatous change", which sounds curious to British ears. The extreme youth of this patient, and absence of convincing pathological evidence, must raise doubts as to the validity of the claim that the growth was a true carcinoma of the colon, rather than a polyp.

Webster[17] (1938) described a fungating growth of the sigmoid in a girl of 9 years and 11 months who survived for four years after operation, but later died with metastases in the cerebellum. This is the longest survival that we could discover.

Warthen[15] (1937), in publishing a case of adenocarcinoma of the transverse colon in a girl of 14, quoted from the literature between the years 1883 and 1934 10 cases of infantile carcinoma (*Table II*). The youngest of these was a boy of 5, with carcinoma of the cæcum, described by Walker and Daly.[14] No details of histology were given by Warthen of these quoted cases.

The following *Tables I* and *II* may be helpful in indicating some details of colonic carcinoma in young children.

Table I.—PARTICULARS OF CASES REPORTED IN THE LITERATURE BETWEEN 1897 AND 1940

AUTHORITY	YEAR	AGE AND SEX OF PATIENT	SITE OF GROWTH	TYPE OF GROWTH	GLAND INVOLVEMENT	VISCERAL METASTASES	SURVIVAL, POST-OPERATIVE OR OTHERWISE
Ball	1935	15, F.	Sigmoid	Mucoid	+	Peritoneum and abdominal organs	10 days
Davis	1929	14, M.	Recto-sigmoid	Mucoid	+	Peritoneum, bladder, ureters	6 months
Drinkwater	1930	15, F.	Descending	Colloid	?	0	8 days
Gerrard	1897	12, M.	Sigmoid	Colloid	?	?	Over 6 months

Table I.—PARTICULARS OF CASES REPORTED IN THE LITERATURE BETWEEN 1897 AND 1940, *continued*

AUTHORITY	YEAR	AGE AND SEX OF PATIENT	SITE OF GROWTH	TYPE OF GROWTH	GLAND INVOLVEMENT	VISCERAL METASTASES	SURVIVAL, POST-OPERATIVE OR OTHERWISE
Kanthack and Furnival	1897	17, M.	Ascending and cæcum	Colloid	?	Peritoneum and gall-bladder	1 year
MacGuire	1939	15, M.	Transverse	Ulcerative	0	Gastrocolic fistula	?
Ogilvie	1935–6	13, M.	Cæcum	Mucoid	+	Brain and skull	4¾ months
Pfeiffer and Wood	1935	7, M.	Transverse	"Fibroma with adenocarcinomatous change"	0 (naked eye only)	?	1 day
Pouzet	1933	14, M.	Ascending	Adenocarcinoma	+	Peritoneum	3½ months
Rawls	1940	12 11/12 F.	Splenic flexure	Colloid	+	Peritoneum and abdominal organs	5½ months
Rocher and Guérin	1931	11, M.	Splenic flexure	Adenocarcinoma	+	Peritoneum	2 days
Wakeley	1933	16, M.	Ascending	Colloid	+	Liver, lungs, abdominal organs	4 months
Warthen	1937	14, F.	Transverse	Adenocarcinoma	+	Omentum and abdominal organs	?
Watts	1927	18, F.	Splenic flexure	Ulcerative	?	?	5 hours
Webster	1938	9 11/12, F.	Sigmoid	Fungating	0	Cerebellum	4 years

15 *cases*: 9 males and 6 females; ages 7 to 18 years.

Sites:

Cæcum	1
Cæcum and ascending	1
Ascending	2
Transverse	3
Splenic flexure	3
Descending	1
Sigmoid	3
Recto-sigmoid	1
	15

Types:

Mucoid or colloid	8
"Fungating"	1
Ulcerative	2
"Adenocarcinoma"	3
"Fibroma with adenocarcinomatous change"	1
	15

Gland Involvement:

Proved	8
Absent	3
Not recorded	4
	15

Visceral Metastases:

Abdominal organs ± peritoneum	9
Brain and skull	1
Cerebellum	1
None	1
Not recorded	3
	15

Table II.—Particulars of 10 Cases quoted by Warthen from the Literature, 1883–1934

Authority	Year	Age and Sex of Patient	Site of Growth	
Maydl	1883	12, F.	Cæcum	No details of histology given by Warthen
Maydl	1883	13, M.	Cæcum	
Burger	1893	15, M.	Ascending colon	
Mayo-Robson	1895	14, F.	Ascending colon	
Nothnagel	1898	12, M.	Cæcum	
Ruczynski	1904	13, M.	Splenic flexure	
Muralt	1913	13, M.	Ascending colon	
Wainwright	1925	11, F.	Splenic flexure	
Chajutin	1929	14, F.	Cæcum	
Walker and Daly	1934	5, M.	Cæcum	

If our 15 cases from the literature are added to those in *Table II*, the sites are as follows :—

Cæcum	7
Ascending	5
Transverse	3
Splenic flexure	5
Descending	1
Sigmoid	4
	25

CASE REPORT

The following personal case provided the stimulus for the present communication :—

History.—An evacuee boy aged 13½ was seen on Dec. 4, 1940, with a history that eight weeks previously he had a sudden pain in the right iliac fossa which had continued intermittently since then ; he vomited frequently ; the bowels were very irregular, but without diarrhœa, and he had been losing weight.

On Examination.—He was a very thin child with a distended and tympanitic abdomen ; the veins were rather prominent, and there was visible peristalsis of the small intestine, showing a typical ' ladder pattern '. No abnormal mass was felt, but the right rectus muscle was rather rigid. Per rectum hard rock-like fæces were present in large quantities.

A diagnosis of subacute obstruction was made, the patient admitted to hospital, and three enemata given during the ensuing 12 hours. The first evacuated many hard fæces, the second was followed by a little blood and slime, and the third returned unchanged. A little flatus was passed, but the boy's condition was obviously becoming more acute.

The following day operation was considered necessary.

At Operation.—A right paramedian subumbilical incision exposed an enormously dilated small intestine, rather reddened in its lower 10 inches, and adherent to a thick succulent appendix. It was at first thought that the appendix was the cause of the obstruction and a few minutes were spent in its removal—a procedure which turned out later to be unnecessary. The cæcum was dilated, though not grossly so. Further systematic examination revealed a mass at the right hepatic flexure feeling like a growth. In view of the boy's age it was at first thought that hyperplastic tuberculosis was a more likely condition than carcinoma, but on enlarging the incision it became obvious that growth was the true diagnosis. The addition of a transverse limb to the right of the paramedian incision enabled a full exposure to be made, when a massive ring carcinoma about the hepatic flexure was exposed. Numerous large glands were also present reaching nearly to the midline. The performance of a

cæcostomy or ileostomy in order to effect temporary drainage of the small intestine before embarking on the major operation of removal, was naturally considered. In view, however, of the boy's small size and emaciation, and because excoriation of the skin (from contents of the small intestine) was likely to be severe in so young a child, these manœuvres, together with any modification of Paul's operation, were ruled out. It was decided—not without some misgiving—to proceed direct with a resection and anastomosis. The last $4\frac{1}{2}$ in. of ileum, the cæcum, ascending colon, and about 3 in. of transverse colon were therefore removed, together with their vessels and numerous palpable lymphatic glands lying on the ileocolic and right colic arteries. The ends of ileum and transverse colon were crushed and inverted and a side-to-side anastomosis performed.

The patient stood the operation remarkably well and at no time caused any anxiety. A fortnight after operation the wound was soundly healed.

The large palpable glands, one or two of which were nearly the size of a walnut, were examined by naked eye at the time of the operation and appeared to be inflammatory in nature. These were sent to the Hospital Pathologist (Dr. C. H. Whittle), who found no signs of malignancy in them. The whole specimen was placed in formalin and later examined in detail by one of us (L. C. M.), when secondary deposits of growth were found in four of the remaining seventeen lymph-glands. (*See below.*)

FIG. 197.—Stenosing growth in the ascending colon. (× $\frac{3}{8}$.)

PATHOLOGICAL APPEARANCES.—

Macroscopical.—The specimen consisted of $4\frac{1}{2}$ in. of terminal ileum, the cæcum, and about 6 in. of ascending colon and transverse colon. Owing to formalin fixation the bowel—particularly the ascending and transverse colon—had shrunk considerably when examined. The appendix was absent.

When opened the bowel showed a white, firm, stenosing growth in the ascending colon, approximately 3 in. from the cæcum. The constriction was about 1 in. broad and had involved almost the whole circumference, leaving only a lumen of about $\frac{1}{2}$ in. diameter (*Fig.* 197).

The growth had involved the whole thickness of the bowel wall on the postero-lateral aspect, but although the serous coat in that area was hard and nodular, the growth had not apparently penetrated through it completely.

Seventeen lymphatic glands, varying in size from $\frac{1}{2}$–$\frac{1}{4}$ in. in diameter, were separated from the fatty connective tissue attached to the colon.

Microscopical.—The growth was a typical colloid carcinoma. Masses of colloid material had infiltrated the submucous layer of the bowel, separating the mucosa from the muscle and infiltrating the latter in many areas (*Figs.* 198, 199).

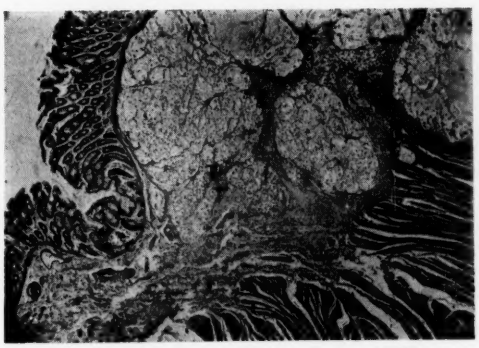

FIG. 198.—Low-power view of the colloid infiltrating between mucosa and muscle, with invasion of the latter.

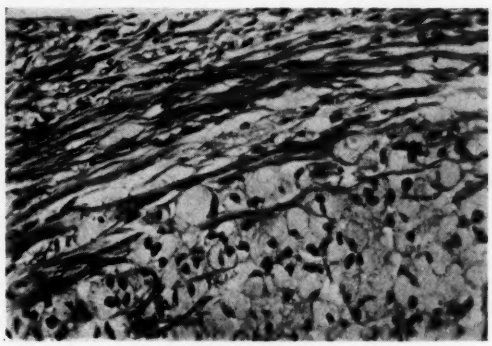

FIG. 199.—High-power view of 'signet-ring' growth cells invading the muscle.

The cellular elements of the growth were typical 'signet-ring' cells, distended with colloid material, and having their nuclei flattened against the periphery.

Lymphatic Glands.—Four of the seventeen glands sectioned were invaded by growth. It was interesting to see that although some deposits were in the form of areas of colloid material surrounded by a layer of flattened cells, others were shown as well-developed acini of mucus-producing cells (*Fig.* 200).

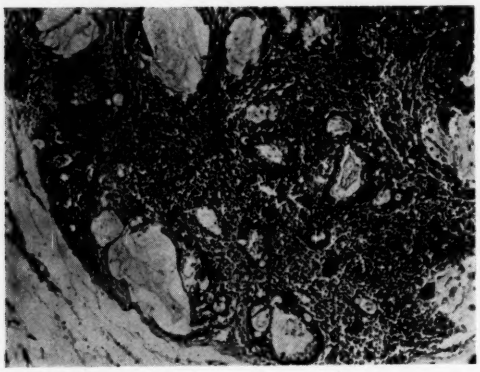

FIG. 200.—Medium-power view of metastases in a lymphatic gland. Areas of colloid are seen as well as fully developed acini.

These histological findings emphasize the necessity of examining every lymphatic gland that can be found in material removed on account of malignant disease. In this case the affected glands were small, averaging about $\frac{1}{4}$ in. in diameter and were only found by systematic dissection. Previous examination of the larger glands alone did not in fact reveal any invasion by growth, thus vitiating an important factor in prognosis of the case.

PROGRESS.—The child made a rapid recovery and was discharged from hospital within a month. He has been seen on several occasions since then by one or both of us. He is thriving extremely, is well covered, and indeed rather fat. He has had no signs or symptoms of recurrence and has been attending school.

September, 1941: The boy is well, growing, and putting on weight, and is now in employment as parcel boy to an Eastern Counties Omnibus Service.

COMMENT

It will be seen from *Table I* that excepting Webster's[16] and Kanthack and Furnivall's[6] cases no patient is known to have survived longer than seven months, so that the prognosis in youthful carcinoma of the colon appears to be almost hopeless. Admittedly many of the recorded cases were inoperable as well as suffering from acute intestinal obstruction, and were thus appalling surgical risks. The remedy obviously lies in earlier diagnosis, which must be dependent upon recognizing the fact that carcinoma of the colon does occur in children.

The disinclination of surgeons to publish such unsatisfactory material may have accounted for the smaller number of cases described by English as compared with American writers. This is perhaps unfortunate, and we are indebted to Wakeley[13] (whose case much resembled ours) for a personal communication urging the publication of the present case.

SUMMARY

1. A brief review of the literature of colonic carcinoma in children is given.

2. A case of carcinoma of the ascending colon in a boy aged $13\frac{1}{2}$ is described, together with operative and pathological details.

3. Stress is laid on the necessity for a careful search for small lymphatic glands—almost in the wall of the bowel—and their microscopy. The large lymphatic glands in the case described were free from metastases, whereas four minute glands, scarcely as large as a pea, were the seat of cancerous deposits.

4. Prognosis, based on published cases, is desperately bad.

5. The fact that youth is no bar to the occurrence of carcinoma of the colon needs better recognition, which would lead to earlier diagnosis and treatment.

We are indebted to Mr. H. P. Hudson, of the Department of Pathology, Cambridge University, for the microphotographs.

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THE CLEAVAGE LINES OF THE SKIN*

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PUNCTURE of the skin with a sharply pointed conical instrument produces a linear or an oval wound, not a circular hole. A series of such punctures, each made in the direction of the long axis of the preceding puncture, marks out the skin surface into a series of straight or curved lines, which constitute the cleavage lines of the skin (*Fig.* 201). In general terms, this cleavage line pattern is constant or has predictable variations.

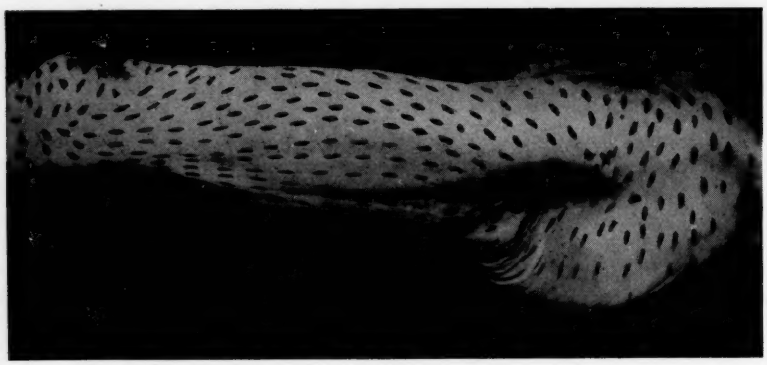

FIG. 201.—Photograph of cleavage lines, on the cadaver, lateral aspect of thigh. Puncture wounds touched with Indian ink.

HISTORICAL INTRODUCTION

The first published anatomical account of the skin cleavage lines was made by Professor A. K. Langer, of Vienna, in 1861.[1]

The first observation of the disparity between the shape of an instrument and the shape of the skin wound produced by it was made by Dupuytren.[2] On August 20, 1831, he was called to treat an attempted suicide at the Hôtel-Dieu, in Paris. This attempt had been made with a stiletto and had resulted in the production of three small precordial wounds. These wounds, Dupuytren observed, were linear, not circular, in shape. He was in some doubt whether to believe the assertions of his patient that the wounds were produced by a round-bladed stiletto, or his own observations, which strongly suggested an instrument with a linear cutting edge as the potentially lethal weapon.

He therefore performed experiments on the cadaver and demonstrated that wounds made in the skin with a conical instrument were linear, not circular, in shape and that the direction of these wounds differed in different parts of the body.

Kocher[3] (1892) was the first surgeon to recognize the surgical importance of the cleavage lines. As a result of his work the cleavage lines in certain parts of the

* An abridged essay based on an M.D. (Camb.) thesis.

body are sometimes referred to as 'Kocher's lines', an example of eponymous nomenclature that has little justification.

No original work on the cleavage lines has been traced since Langer's original exposition in 1861 and Kocher's contribution in 1892. Few references to them occur in current literature. Foman[4] and Kilner,[5] however, insist upon the advisability of making all incisions in the cleavage lines where feasible. This investigation was undertaken because the whole subject of the cleavage lines, both in its theoretical and practical aspects, has never received the recognition that its importance merits.

DEMONSTRATION AND RECORDING OF THE LINES OF CLEAVAGE

The lines have been worked out on unclaimed bodies. From different parts of 28 bodies, 107 photographs have been taken, making a total of at least 5 complete bodies. The instrument selected to pierce the skin was a metal-pointed wooden marline-spike (the part that enters the skin exactly resembles the end of a sharply pointed pencil); its actual length was 16 in.; and 1 in. from its point the diameter measured $\frac{3}{8}$ in. A few turns of elastoplast wound round the instrument near the point form a simple adjustable check that will ensure any fixed depth of penetration and therefore a series of punctures of any required length, an average being $\frac{3}{8}$ in. The skin is pierced and the direction of the puncture observed; a second puncture is made in the direction of the long axis of the preceding puncture and the process is repeated until the whole part is covered. The punctures are touched with Indian ink to render them clearly visible, and the whole part photographed (*Figs.* 201, 202). *Figs.* 203 and 204 are diagrammatic representations of the cleavage lines based on the photographs of actual specimens. It must be stressed that the lines in these diagrams are for an individual of average build.

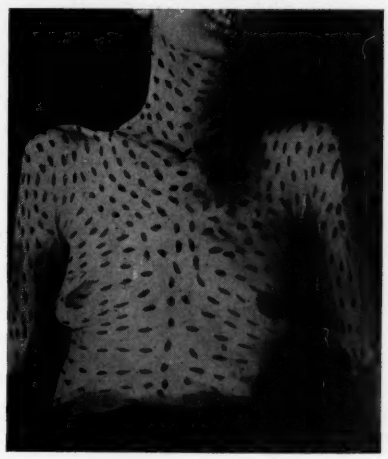

FIG. 202.—Photograph of cleavage lines on anterior aspect of thorax, etc.

Results of the Investigation.—

1. Photographs of approximately 22,600 puncture wounds made under the conditions described have confirmed beyond doubt the existence of the lines of cleavage.

2. It has been found that the line pattern shows variations according to body configuration (degree of muscular development, emaciation, sthenic and asthenic types, etc.) and is only constant for bodies of similar build.

3. The line pattern in the upper extremity, however, forms an exception to this rule, as it is variable within the limits of the same type of body build.

4. The existence has been confirmed of limited areas of skin in which the punctures are torn triangular wounds or lie in confused groups, as described by Langer.

Fundamental differences exist between the present series and Langer's lines. These are found mainly on the postero-medial aspect of the thigh, sole of the foot,

anterior and posterior aspects of the upper extremity, and in the region of Poupart's ligament. Langer's diagrams show variations according to age. This series indicates a close and fixed relation between line pattern and body configuration. It is the shape of the body rather than its years that is the operative factor. The variability and, in some cases, the irregularity of the upper extremity pattern for bodies of similar build, has been missed by Langer.

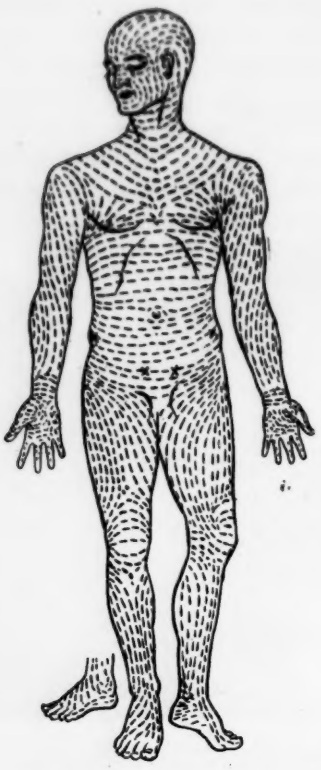

FIG. 203.—Diagram of cleavage lines. Crosses mark the site of anterior superior spine, pubic spine, and upper extremity of great trochanter.

FIG. 204.—Diagram of cleavage lines. Crosses mark the site of the posterior flexion crease of the knee.

THE CLEAVAGE LINES IN EXCISED SKIN

Examination of the cleavage lines worked out on skin removed from the body shows that the line pattern remains unaltered. This affords conclusive proof that whatever influences extrinsic factors may have had in originating and moulding the line pattern, its maintenance is purely intrinsic.

MICROSCOPICAL EXAMINATION OF SKIN SECTIONS

Skin sections were made in two planes, one exactly at right angles and one exactly parallel to the long axis of a linear puncture wound (*Figs.* 205, 206). Examination of these sections demonstrates a striking difference in structure according to the plane of section. Sections at right angles to the long axis show a marked preponderance of connective- and elastic-tissue fibres cut transversely. Sections

parallel to the long axis show a similar preponderance of fibres running longitudinally. The majority of the fibres, therefore, run parallel to the long axis and the remainder interlace. The direction of cleavage demonstrates the direction of the majority of the fibres, so that the whole line pattern becomes a visible demonstration of the lay-out of these fibres. The interlacing arrangement of fibres hitherto stressed as the primary, indeed the only feature, of skin structure, should be relegated to a subsidiary position. The primary feature is the parallel arrangement of the connective- and elastic-tissue fibres forming sheets or strands running in the cleavage lines.

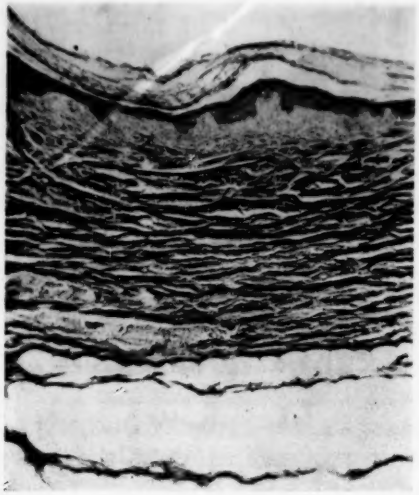

FIG. 205.—Skin section cut parallel to oval puncture wound, showing parallel arrangement of fibres. (Mallory stain.)

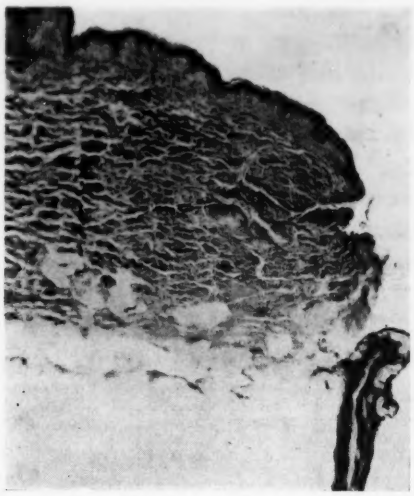

FIG. 206.—Skin section cut at right angles to oval puncture, showing fibres cut at right angles. (Mallory stain.)

Grey, Cunningham, Scharpey-Scafer, Bloom, and Ramon Cajal describe these fibres as constituting a closely interwoven felt. Morris and A. Rauber (1902) alone refer to Langer's work. Perfunctory examination of the skin does reveal its structure as a closely woven felt only with an apparently haphazard and purely chance arrangement of its fibres. It is only when the sections are orientated round a linear puncture wound as described, that the very definite additional design to which these fibres conform becomes clear.

AETIOLOGY

Skin incisions are followed by skin retraction, the amount of retraction being a measure of the amount of tension. Retraction has been found to be minimal in incisions in the cleavage lines and maximal in incisions made at right angles to these lines. This affords conclusive proof that the cleavage lines are lines of increased tension.

This difference in skin retraction according to the direction of the skin incision is minimal in the skin of the palms of the hands, soles of the feet, and on the face. On the hands and feet retraction is prevented by the fixation of the skin to the underlying fascia. On the face lines of permanent increased tension could not exist without adversely affecting the symmetry of facial expression when at rest.

It is probable that tension here is intermittent and is produced by the contraction of the facial muscles.

As the cleavage-line pattern is maintained in excised skin, the lines of increased tension must produce intrinsic structural changes. It is suggested that the connective- and elastic-tissue fibres in the skin under the influence of lines of increased tension assume a longitudinal disposition in these lines and thus constitute well-defined and extensive fibre tracts. With regard to the arrangement of its connective- and elastic-tissue fibres the skin may be said to share with bone the latter's well-known power of adaption of structure to function, in particular its power to alter its structure in relation to mechanical stresses. It is not devised on a plan that is fixed and predetermined, but rather on one that permits a changing structure with alterations in body configuration.

Stated briefly, the sequence is as follows: The skin is under tension; lines of increased tension develop; by a process of adaptation of structure to function the majority of the connective-tissue and elastic fibres become arranged longitudinally in these lines; the introduction of a sharply pointed conical instrument into these parallel fibres pushes them aside, leaving a slit; a series of such slits constitutes the cleavage lines.

CLEAVAGE LINES AND CREASE LINES

This relationship is clearly an important one, as the crease lines are visible, and if they coincided with the cleavage lines would reveal the direction of the latter. In general terms the crease lines, with certain notable exceptions, have been found to coincide with the cleavage lines. These exceptions occur mainly on the palms of the hands, the soles of the feet, the flexor aspects of the knee and elbow, and extensor aspects of the ankle. As already stated, the cleavage lines are lines of increased tension; the crease lines with which they coincide must therefore also be lines of increased tension rather than lines of rest as suggested by Ogilvie.[6]

THE IMPORTANCE OF THE CLEAVAGE LINES

To Anatomy.—The modern conception of the connective- and elastic-tissue fibres of the skin as constituting an irregular mosaic appears to be no longer tenable. The theory put forward in this paper emphasizes the existence and importance of the parallel arrangement of the majority of the fibres which constitutes sheets or strands running in the lines of increased tension, thus forming the lines of cleavage. The interlacing arrangement of the minority of the fibres binds the parallel fibres into a coherent whole. This parallelism of the skin-fibres remains hidden when the skin is sectioned at random and can only be demonstrated by orientating the skin sections around a narrow slit puncture. Skin puncture, therefore, becomes an essential preliminary to skin section.

To Surgery.—Incisions in the cleavage lines leave fine linear scars. Incisions at right angles to these lines leave widely stretched unsightly scars. The newly formed scar tissue in these latter incisions stretches because it is subject to the full force of the lines of increased tension which now run at right angles to the line of incision. In planning an incision much emphasis has been correctly laid on its direction in relation to the access it provides, and the trauma it imposes on underlying structures. In closing an incision surgical fashion has at different times

dictated a variety of methods of skin approximation in an endeavour to obtain a fine linear scar. The one decisive factor in the production of a fine linear scar is not so much any particular method of wound suture, but rather the relation which the direction of the incision bears to the cleavage lines. An incision that has been accurately placed in the cleavage lines in the whole of its course, and therefore in the lines of increased tension and parallel to the connective- and elastic-tissue fibres, will leave the finest scar.

Symmetrical retraction of the skin edges is seen to follow incisions that are accurately placed in the cleavage lines. It is a matter of common observation, however, that asymmetrical retraction usually follows certain incisions, e.g., MacBurney's incision and the classical approach for inguinal hernia. These incisions in the whole or part of their course, strike obliquely across the lines of cleavage; the wound edges thus become subject to a tension force that varies in direction in different parts of the wound. This asymmetrical retraction after incision can be demonstrated by observing the shift that takes place in each part of the preliminary skin scratches made across the line of incision to facilitate accurate wound suture. The amount of shift between the two parts of each skin scratch indicates the difference in direction between the line of the skin incision and the lines of cleavage. When no shift exists the incision has been accurately placed in the lines of cleavage (or is at right angles to them).

The horizontal goitre incision is one of the few standard incisions that lies precisely and wholly in the lines of cleavage. Of all incisions this leaves the finest and least noticeable scar. Vertical L- or T-shaped incisions for excision of tuberculous cervical glands have now been discarded in favour of horizontal incisions.[7] The vertical components of the former, being placed across the lines of cleavage, leave stretched, and therefore unsightly, scars.

The importance of the scar in abdominal surgery is greatly overshadowed by more major issues involved. There are, however, two standard incisions the direction of which should be changed so that it lies in the lines of cleavage without adversely affecting the soundness of the approach; these two incisions are the classical incision for inguinal hernia and the MacBurney approach for appendicectomy. Both these incisions it is suggested should be horizontal in direction, with a slight downward swing, the former commencing over the middle third of Poupart's ligament, the latter medial to the anterior superior spine. Ogilvie's observations[6] on the direction of the incision for inguinal and femoral hernia are well worth quoting: "I personally prefer to use this suprapubic skin crease for the incision in all operations for inguinal and femoral hernia. . . . The standard inguinal incision leaves a scar which is rarely sightly, sometimes keloid, and occasionally painful; these drawbacks are partly the result of its direction being in the line of tension of the skin instead of in the line of rest as is a crease incision, and partly due to its encroachment at the lower end on skin that is sterilized with difficulty." These remarks are laudable in that they represent one of the first attempts in general surgical literature to improve the appearance of the scar by altering the direction of the incision and therefore recognize the underlying principle that the appearance of the scar is dependent on the direction of the incision, but fallacious in their reasoning as they attribute unsightly scar formation to placing the incision in the line of tension. This is the exact opposite of what I have found to occur. The crease lines have been shown to be lines of increased tension, not lines of rest.

The insistence on placing an incision in the crease lines is apt to be misleading, as the incision is equally ideal when situated above or below the crease lines, provided that it lies in the cleavage lines; furthermore it is impractical in those not uncommon cases in which the crease lines cannot be identified.

The development of a keloidal scar in one limb of a T- or L-shaped incision has been observed.[8] An incision across the cleavage lines differs from an incision in them in two important respects: it divides more fibres, and the resultant scar is subject to more tension. It is suggested that these two factors, either singly or in combination, produce a stimulus to overgrowth of the cut fibres and must be regarded as one aetiological factor in keloidal scar formation.

SUMMARY

1. The cleavage lines have been re-investigated by gross and microscopical methods.

2. Differences between the cleavage lines as determined in the present series and those worked out by Langer, have been indicated.

3. A relation between cleavage-line pattern and body configuration has been discovered.

4. The cleavage-line pattern has for the first time been worked out on excised skin.

5. The aetiology has been discussed.

6. A new conception of the arrangement of the connective- and elastic-tissue fibres of the skin has been described.

7. The practical importance of the lines of cleavage has been stressed, especially in its relation to incisional surgery.

It is, finally, a pleasure and a very great privilege to record my debt to Professor Wood Jones, of the Anatomical Department of the University of Manchester, for suggesting the subject for investigation, and to Dr. Greenwood, Medical Superintendent of Withington Hospital, for access to the human material. The excellent skin sections and microphotographs are the work of Mr. Gooding, of the Anatomical Department. The black and white diagrams of the cleavage lines have been constructed with great skill by Miss Davison.

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SPONTANEOUS FRACTURE OF THE APPARENTLY NORMAL NECK OF THE FEMUR

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THE following case is reported because there is no similar case in the English literature, and because 'overstrain' or march fractures are likely to increase in frequency during the war.

CASE REPORT

A healthy young man, aged 27, a milk salesman in civil life, joined the Army in June, 1940. In November he was posted to a unit which was undergoing the most intensive training in the British Army, involving very long route marches (the patient did one of 42 miles in 20 hours), cross-country runs, extensive manœuvres, etc. In March, 1941, he went for a cross-country run of 4 miles, which he had often done before, and which entailed running down a steep hill. He completed this without any misadventure, but noticed stiffness in the left hip afterwards. Three days later he went on a route march, but had to fall

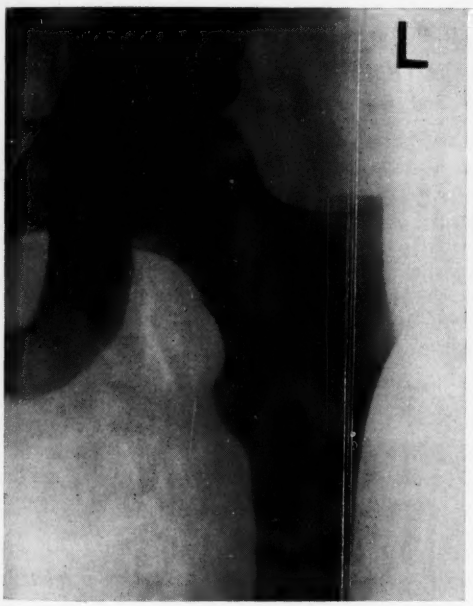

FIG. 207.—Radiograph showing a trans-cervical fracture of the neck of the left femur, half an inch proximal to the intertrochanteric line and parallel to it.

FIG. 208.—Radiograph taken with the tube tilted 15° in the sagittal plane.

out after 9 miles owing to increasing pain in the left hip. He underwent no further exertion till the unit returned to billets nine days later, when he was sent to hospital, barely able to hobble along.

Clinical examination revealed no abnormality on inspection; he was tender over the left greater trochanter, in Scarpa's triangle, and on the left side of the perineum. Flexion, abduction, and external rotation of the left hip were full, but painful at the extremes of movement, the pain always being felt in the adductor region. Extension, adduction, and internal

FIG. 209.—Radiograph taken two weeks later, showing that the gap in the upper margin of the neck had closed. The fracture line is still apparent and the splintering on the inner margin present.

FIG. 210.—Radiograph taken three weeks later than *Fig.* 209. The fracture line shows increased density, and the splintering is rounding off.

rotation were full and painless. A radiograph (*Fig.* 207) showed a trans-cervical fracture of the neck of the left femur, half an inch proximal to the intertrochanteric line, and parallel to it. The fracture shows as a gap in the continuity of the upper margin of the neck, passing into the bone at a right angle to the cortex; thence it is continued across the neck as a fine, irregular, but nevertheless definite line, terminating with splintering of the cortex of the lower margin of the neck. The fracture appears to be an adduction fracture, with a gap at the upper and outer margin of the neck, and splintering and impaction at the lower and inner margin. The right hip was normal, and the fracture did not show in the lateral view. Plates were taken at different angles to try to demonstrate the fracture more clearly, and a plate taken with a tilt of the tube of 15° in the sagittal plane (*Fig.* 208) gave a better picture.

FIG. 211.—Final radiograph, seven weeks after admission. The rounding off of the splintering is proceeding, and the fracture line is less definite, repair being almost complete.

The patient rapidly recovered from his symptoms after a few days in bed, non-weight bearing movements being encouraged. A further plate taken two weeks later (*Fig.* 209) showed that the gap in the upper margin of the neck had closed, but the fracture line was still apparent, and the splintering on the inner margin still present. He was now allowed up with crutches, and was free from symptoms and signs. Three weeks later a further plate

(*Fig.* 210) shows the fracture line as a line of increased density, and the splintering is now being rounded off. He was now allowed to bear weight increasingly, which he did without ill effect. Two weeks later (seven weeks after admission to hospital) another radiograph (*Fig.* 211) showed further rounding off of the splintering and a less definite fracture line, repair being almost complete.

COMMENT

The interesting points are: (1) The absence of any history of injury, even after close and repeated questioning; (2) The definite history of repeated severe physical strain; (3) The gradually increasing disability, rapidly relieved by rest; (4) The normal appearance of the bone texture as seen in the radiographs; (5) The gradual obliteration of the fracture line without the appearance of callus.

The first four points are characteristic features of march fractures. With regard to the normal texture of the bone as seen in the radiographs, Reischauer[1] suggests that where a number of cases of 'overstrain' fracture occur in a group of men exposed to the same strain, it is reasonable to suppose that the aetiology is overstrain of normal bone; but where a single case occurs in a group of men exposed to the same strain, it is possible that such a case is a manifestation of a subclinical bone disease. There must be a complete gradation from normal bone to definitely abnormal bone, as seen in the deficiency diseases and in the constitutional diseases of bone, in which pathological fracture is often a feature. In the case reported, the serum phosphorus was 3·6 mg. per cent (King's method), and the serum calcium 9·2 mg. per cent (Trevan and Bainbridge's method). The former is normal, the latter is at the low limit of normal. The Wassermann reaction was negative, and the genearal health first class.

A characteristic feature of march fracture is that the fracture line is seldom easily visible in the radiograph, and the diagnosis is usually made by the demonstration of calcified callus around the fracture site. Many authors have stressed that the diagnosis may be missed in the early stages by the absence of this callus. In the case under review, callus was never more than just present, and the fracture line was always clearly visible. This is exactly opposite to the usual findings in march fractures in the metatarsals, but callus is never a prominent feature in fractures of the neck of the femur. Reischauer,[1] though he gives no case reports, appears familiar with spontaneous fractures of the neck of the femur, which seem to have been reported in Finnish soldiers. Reischauer states that they appear as a clear line, a millimetre wide, crossing half the neck of the femur from below, and that they do not give rise to the formation of callus. As I understand him, he thinks that these clear lines seen in the radiograph represent a zone of reconstruction in the bone, rather than a fracture, first because they occur at a site at which fracture is not to be expected, and secondly because they do not give rise to callus formation. I agree that a clear line due to fracture is not likely to be found on the inner border of the neck of the femur, because an abduction strain would be required to produce it. The type of case which he describes differs from mine, however, for in my case the clear line starts on the outer border of the neck, and there is impaction and splintering on the inner margin of the neck. An adduction strain would be needed to produce this fracture, and an adduction strain is provided by weight-bearing; and in the case of a soldier marching long distances carrying a heavy pack, rifle, etc., this strain might easily prove sufficient to produce fracture. These features—namely, the splintering, and the slight

adduction displacement of the fragments—indicate a fracture rather than a process of reconstruction, in spite of the absence of callus.

March fractures of the metatarsals are well known. Jackson Burrows[2] has recently described two cases of spontaneous fracture of the apparently normal fibula in its lowest third. He quotes Hopfengartner,[3] who described a considerable number of cases of spontaneous fracture of the upper end of the fibula. Reischauer[1] also mentions spontaneous fracture of the shaft of the femur, of the upper and middle thirds of the fibula, of the inferior ramus of the pubis, and of the tuberosity of the os calcis, but gives no case reports. The article deals mainly with spontaneous fractures of the shaft of the tibia, which he illustrates with serial radiographs. An article[4] entitled " Spontaneous fractures of the neck of the femur on one side, and of the diaphysis of the femur on the other side, occurring three years apart, in an adult with no evidence of bone or nerve disease ", is unfortunately unavailable in this country.

SUMMARY

A case of spontaneous fracture of the neck of the femur in a healthy adult is recorded.

The similarity of this case to other cases of march fracture is discussed.

A brief review of the relevant literature is given.

I am most grateful to Mr. R. L. Horton, under whose care this patient was, for permission to report the case, and for his help in doing so.

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DUODENAL ATRESIA
WITH A CASE REPORT OF A SUCCESSFUL GASTRO-ENTEROSTOMY

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DUODENAL atresia is a rare condition, but a review of the literature seems to show that it occurs more commonly than is generally believed. Its importance lies in the fact that early diagnosis and surgical intervention holds out a prospect of cure in a condition that otherwise almost invariably ends fatally. Calder first described the condition in 1733, but it was not till 1916 that Ernst,[1] of Copenhagen, reported the first case successfully treated by operation. Since then a number of cases have been reported, but with very few successes.

Occurrence.—The incidence of duodenal atresia is estimated at 1 in 20,000, according to Young and Mueller.[2] Davis and Poynter[3] have shown that the duodenum has a marked predisposition to atresia. In a report of 392 cases of atresia of the intestine they found that atresia of the duodenum occurred in 134 subjects. Ladd,[4] in a series of 60 cases of atresia of the intestine, gave the following differential count: duodenum 19, jejunum 8, ileum 27, with multiple atresia in 15. Seidlin,[5] in 1925, and Sheldon,[6] in 1926, also showed the high proportion of cases of atresia occurring in the duodenum. Sheldon, in a series of 6000 autopsies at Great Ormond Street, found 26 cases of atresia of the intestine. The sex incidence is fairly even, but males seem to preponderate slightly. In Ladd's 60 cases, 33 were males and 27 females.

Anatomy.—Buchanan[7] describes duodenal atresia as being extrinsic or intrinsic. The extrinsic causes are the following: (1) Peritoneal bands; (2) Adhesions; (3) Anomalous blood-vessels; (4) Torsion; (5) Volvulus. Operation cases of the above have been reported by Higgins and Patterson,[8] Buchanan,[9] and Potter.[10]

Three types of intrinsic atresia are generally recognized (*Fig.* 212): (1) A formed

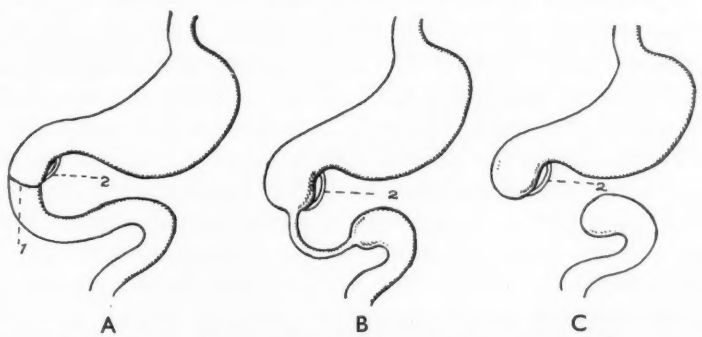

FIG. 212.—Illustrating the three types of intrinsic atresia. A, Formed duodenum with diaphragm across the lumen; B, Blind ends connected by a cord which may or may not have a lumen; C, Blind ends without any connexion. 1, Diaphragm across duodenum; 2, Common bile-duct.

duodenum with a diaphragm across the lumen; (2) Blind ends connected by a cord which may or may not have a lumen; (3) Blind ends without any connexion.

Brodsky[11] believes that the term congenital atresia is incorrect if applied to all types, as he considers that duodenal obstruction in the newborn may be due to stenosis, stricture, atresia, and occlusion, terms which are not interchangeable. This, however, appears to be an unnecessary refinement, and if by congenital atresia obstruction is presupposed, the above classification gives a simpler and clearer picture of the condition. The site of the obstruction is usually in the neighbourhood of the ampulla of Vater. In Davis and Poynter's 134 cases, 59 were above and 75 below the ampulla. In a number of cases, a thread-like lumen was found through the obstruction, and in nearly all cases the gut below the obstruction was narrowed, largely by collapse.

Aetiology.—The cause of the condition is not yet definitely established. Tandler[12] has shown that the human embryo of 30 to 60 days has a solid duodenum. Ladd believes that complete or partial failure of the transition from a solid cord to a hollow tube is the cause of duodenal atresia. Forsnerr[13] believes it to be due to overdevelopment of the forerunners of the villi. Bland-Sutton[14] states that the defect occurs, like most developmental errors, at the site of a developmental junction—in this case where the foregut and midgut meet.

Pathology.—The structure of the obstruction has been differently described by various authors. In the extrinsic type the obstruction is due to the pressure of peritoneal bands, adhesions, mal-rotation of the gut, or anomalous blood-vessels, especially the superior mesenteric artery and vein, as in the cases reported by Buchanan and Potter. In the intrinsic type Wangensteen[15] has found that it is composed of a fibrous cord or a fibrous diaphragm. Sheldon describes a thin cord with all the intestinal layers present, but the mucosa fused, causing obliteration of the lumen. Davis and Poynter agree with this, but point out that a thread-like lumen through which a probe can pass may exist through the obstruction. Brodsky has reported a case in which the gap between the blind intestinal ends was filled by a solid mass of pancreatic tissue.

Diagnosis.—The diagnosis rests on the following five points: (1) Persistent vomiting from birth. (2) The vomit usually contains bile and sometimes pure or altered blood, and is usually projectile. (3) Fullness in the epigastrium with or without peristaltic waves from left to right. (4) Constipation from birth, though meconium may be passed. (5) Radiographs with the aid of a barium meal.

Many writers regard the presence of bile in the vomit as pathognomic of the condition in the newborn, but as it has been shown by Davis and Poynter that in a proportion of cases the obstruction is above the ampulla of Vater, bile cannot be vomited in cases of complete atresia occurring above the ampulla.

The importance of early diagnosis cannot be over-estimated, as several cases in the literature show that the diagnosis was not confirmed till autopsy or arrived at too late to allow surgery to be effective in an already dehydrated infant. Radiographs with a barium meal are of the greatest value in confirming the clinical diagnosis and determining whether the atresia is complete or partial. Farber has described a diagnostic test for the condition by microscopical examination of the meconium for amniotic cells. Other congenital defects, such as spina bifida, cleft palate, or imperforate anus, may also be present.

The differential diagnosis rests between duodenal atresia, atresia elsewhere in the gut, congenital hypertrophic pyloric stenosis, and an œsophageal pouch. In duodenal atresia the vomiting occurs from 10 to 20 minutes after taking food. If the atresia is lower down in the gut this time interval is longer. Hypertrophic pyloric stenosis seldom develops before the age of three weeks, is never characterized by vomiting from birth, and a tumour is usually palpable. An œsophageal pouch usually produces vomiting immediately after taking food, and constipation is not complete. A barium swallow and a barium meal are often essential to distinguish between the different conditions.

Prognosis.—In infants in whom duodenal atresia is complete or is of such a degree that surgical intervention is necessary, the prognosis is poor, as indeed it must be in any condition calling for major surgery in the first few days of life. Davis and Poynter estimate the mortality at 99·5 per cent. Donovan,[16] of New York, has reported 2 successful cases. Feggetter,[17] in reporting the latest successful case in England (1940), states that he can find an account of only 6 previous successful cases. In those cases, a small minority, in which the atresia is only partial and the vomiting is not sufficient to require surgery in the first week or so, operation may be resorted to later with a greater prospect of success. Potter reported such a case requiring operation at the age of 6 years, and Lennox Gordon[18] one in which operation was necessary at the age of $2\frac{1}{2}$ years.

TREATMENT

Once the diagnosis is established, and it is clear that the atresia is marked, operation holds out the only hope of recovery. In extrinsic cases division of bands or untwisting of a volvulus or torsion, if practicable, may be all that is necessary. If the bands contain important structures such as the superior mesenteric blood-vessels, they cannot be divided, and the problem which presents itself is exactly the same as in the intrinsic type.

In intrinsic cases the choice of operation lies between a gastro-enterostomy and a duodenojejunostomy. Donovan states that he has found a right subcostal incision gives the best access to these cases. He believes that anterior duodeno-jejunostomy gives the best results, and he regards an entero-enterostomy as unnecessary. Other writers, among them Ernst and De Witt Stetten,[19] used an anterior duodenojejunostomy on their cases, while Higgins,[20] Browne,[21] and Feggetter performed a posterior gastro-enterostomy, considering this to give a better functional result. Tallerman and Levi[22] made use of an anterior gastro-enterostomy, but convalescence was particularly stormy and vomiting was so marked as to call for a second operation, a gastrostomy, whereby a tube was passed through the stoma into the jejunum. It would seem, therefore, that an anterior duodenojejunostomy or a posterior gastro-enterostomy has the best chance of succeeding. Posterior gastro-enterostomy is only slightly more difficult than the anterior type. The transverse mesocolon is thin in children but not unduly short, and the middle colic artery can usually be easily avoided. The technical difficulty of the operation lies principally in the disparity in lumen between the dilated and often hypertrophied stomach and the thin, friable, and collapsed jejunum. In one case reported in the United States, Walter E. Lee performed a jejunostomy and kept the child alive by jejunal feeding for eight months, till he considered it was fit enough to stand

the gastro-enterostomy. Morton[22] described a case with a diaphragm obstruction only, across a well-formed duodenum. In this case all that was necessary was division of the diaphragm through the duodenum with an electric knife.

Table I.—Synopsis of Cases Successfully Treated by Operation

Author	Age	Operation	Result
Ernst[1]	11 days	Duodenojejunostomy	Recovery
Higgins[20]	22 days	Posterior gastro-enterostomy	Recovery
Steward[24]	5 days	Posterior gastro-enterostomy	Recovery
Browne[21]	21 days	Posterior gastro-enterostomy	Recovery
Bolling[25]	9 days	Duodenojejunostomy	Recovery
Abel[26]	8 weeks	Posterior gastro-enterostomy	Recovery
Donovan[16]	(1) 8 days (2) 17 days	Duodenojejunostomy	Recovery
Stetten[19]	3 days	Duodenojejunostomy	Recovery
Feggetter[17]	4 days	Posterior gastro-enterostomy	Recovery
Tallerman and Levi[22]	11 days	Anterior gastro-enterostomy	Recovery after second operation

Table I gives a list of cases successfully treated by operation, with the age of the infant at operation and the operation performed. In all these cases it is emphasized that the pre-operative and post-operative care are at least as important as the operation itself. The chief pre-operative measure is to restore fluid to the dehydrated infant and provide it with a large sugar reserve. Calcium gluconate has also been advocated, and gentle gastric lavage will clean the stomach and increase its muscle tone. After the operation the aim must be to maintain the fluid intake and limit the fluid loss. Vomiting takes place for about five days after operation, as pointed out by Donovan and De Witt Stetten. An intravenous drip saline and glucose are therefore essential for at least 48 hours. The vomiting is probably due to œdema of the stoma during the first two or three days, and this gradually disappears. A Ryle's tube may be passed to withdraw the stomach contents if necessary. The child may start small regular feeds, half an ounce every two hours, twenty-four hours after operation. This is gradually increased. Sterile water, glucose, and saline are recommended for the first forty-eight hours of feeding, but after that breast milk is considered the best food for the child. If this is unobtainable proprietary foods may be used. The addition of 5–10 min. of brandy every four hours in a feed acts as a stimulant and increases the appetite to a marked degree, and cod-liver oil, 1 drachm three times a day, is a useful adjunct. An occasional milligramme of stilbœstrol is said to be of value. The bowels can be kept regulated, if necessary, by the judicious use of liquid paraffin and kaolin. The weight may not rise steadily for the first few weeks after operation and glucose and saline given between feeds helps to remedy this. If breast milk

cannot be used, or is found to be unsuitable for the child, different proprietary preparations must be experimented with, but if the child is alive and well three weeks after operation, patience and care are all that should be necessary to ensure its survival.

CASE REPORT

HISTORY.—The patient, a dehydrated but otherwise healthy infant of 3 days of age, was admitted to the North Middlesex Hospital on December 25, 1940. The parents stated that the child had vomited every feed since birth. The vomit contained bile but no blood, occurred about fifteen minutes after feeding, and was sometimes projectile in character. Meconium had been passed once, but no other bowel motion had occurred. Urine had been passed normally. There had been one previous child, who had had a spina bifida and had not survived.

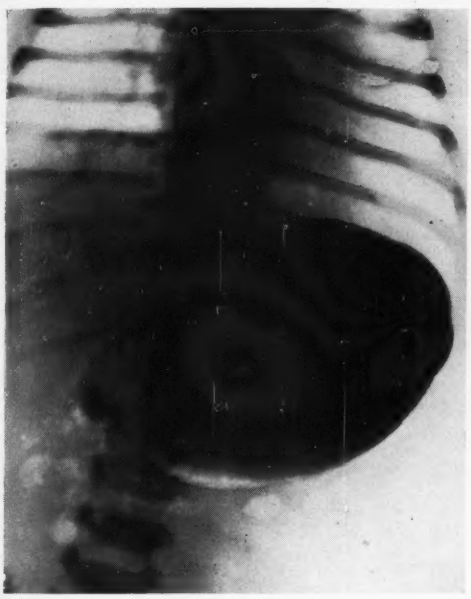

FIG. 213.—Before operation. Radiograph taken 10 minutes after barium meal was given, showing all the barium in a dilated stomach and œsophagus.

FIG. 214.—Radiograph taken 1 hour after the first picture. Only about one-eighth of the barium has filtered into the intestine; the rest still distends the stomach and œsophagus.

PHYSICAL EXAMINATION.—The child was a well-formed female infant weighing just over 6 lb. She was slightly jaundiced. No obvious congenital malformation could be found. There was some fullness in the epigastrium, but no other clinical sign could be elicited. Rectal examination revealed nothing beyond the fact that the rectum was patent and empty. A feed, which was taken well, was given, and the child was watched. Peristaltic waves were seen in the epigastrium, passing from left to right, and the child vomited forcibly twelve minutes after taking the feed. A small barium meal was given and the child screened. The stomach and first part of the duodenum were seen to fill well, but nothing could be seen to pass on into the intestine. An X-ray picture was taken, and repeated one hour later (*Figs.* 213, 214). The first picture showed all the barium in a dilated œsophagus, stomach, and first part of the duodenum. The second picture showed about seven-eighths of the barium still in the stomach and still distending the œsophagus. A very small amount of barium was seen to have passed through a narrow lumen in the lower duodenum into the small intestine.

A diagnosis of subtotal atresia of the duodenum was made.

TREATMENT.—An effort was made to see if the child would keep down any sort of food in any amount, but everything that was tried was vomited about fifteen minutes after feeding. It was decided to operate, but operation was deferred to the next day to allow the stomach to be rested and cleaned by gentle gastric lavage, and the child's fluids restored with subcutaneous saline.

AT OPERATION.—The operation was performed by the author, assisted by Mr. Hayson. The anæsthetic was vinyl ether, given by Dr. Quayle, and local novocaine 1 per cent. The child was bandaged to a cross to steady it. A midline incision was made and a dilated stomach at once presented. The first part of the duodenum was seen to be also dilated. At the point where the bile-duct entered the gut, the duodenum rapidly narrowed, and the bore of the second and third parts was less than that of a lead pencil. The jejunum was very collapsed, but otherwise appeared normal (*Fig.* 215). A rapid exploration revealed no other abnormality in the abdomen. A posterior gastro-enterostomy, with a stoma of about one inch in the oblique axis of the stomach, was performed in two layers. No clamps were used. A continuous through-and-through suture was used for the first layer, and a continuous inverting Connell suture for the second layer, both of 00 catgut. The transverse mesocolon was sutured to the stomach wall. At this point the child became rather cold and the pulse deteriorated. Hot packs were placed in the abdomen and the condition improved. The wound was then closed in layers as quickly as possible with continuous 00 catgut for the peritoneum, and interrupted No. 1 catgut sutures for the rectus sheath. The skin was sutured with interrupted sutures of fine silkworm gut.

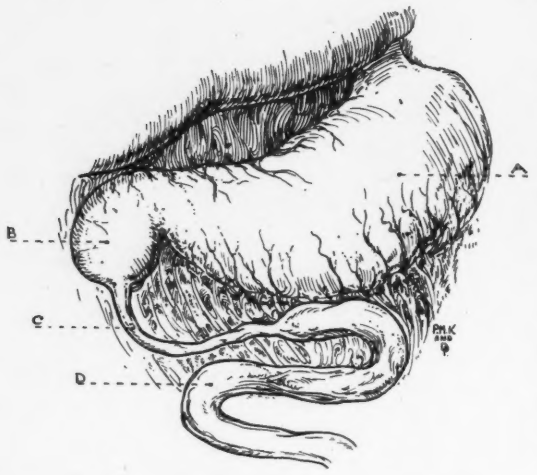

FIG. 215.—Diagrammatic operation sketch, showing subtotal atresia of the second and third parts of the duodenum. A, Stomach; B, Dilated first part of duodenum; C, Atresic duodenum; D, Collapsed jejunum.

POST-OPERATIVE PROGRESS.—An intravenous drip saline and glucose was started as soon as the child had been warmed up in bed for half-an-hour. This was continued until the third day. Feeding by mouth was started with half an ounce of sterile glucose and water every two hours. After twenty-four hours this was increased to half an ounce every hour and gradually increased every twelve hours. Vomiting occurred for five days. About half of each feed was vomited at first, but by the third day the vomiting was much less and had stopped by the fifth evening. Subcutaneous saline was given, 20 c.c. three times a day for a week, after the intravenous saline was stopped. The child was weak for the first few days, but then rapidly improved. The appetite was not good and 5 min. of brandy were given four-hourly in a feed. This had a marked effect in increasing the appetite. Cod-liver oil, 1 drachm, was given three times a day. Unfortunately, the mother was unable to nurse the child, first getting influenza and then scarlet fever, and the child was fed on Cow & Gate half cream. Convalescence was uneventful, except for a small stitch abscess in the lower end of the wound, which soon cleared up.

A month after operation a barium meal was given and the child X-rayed (*Figs.* 216, 217). It was then seen that, though some dilatation of the œsophagus persisted, the stomach emptied well through the gastro-enterostomy, and an hour after the meal was given was practically empty.

Two months after operation the child's general condition had improved to a considerable degree. Four-ounce feeds of Cow & Gate, full cream, were taken with relish three-hourly, the infant howling lustily if kept waiting. The bowels opened regularly, and though sometimes tinged with green, were otherwise normal. There was no vomiting, though slight regurgitation occurred if the child was allowed to bolt its feed. The child's weight was the only cause for dissatisfaction. This had dropped after operation to 5 lb. 6 oz., and two months after operation had risen slowly to 6 lb. 4 oz. It was found that breast milk was the best

food to give it in this respect, but the absence of the mother and the present difficult circumstances made it very awkward to get a regular supply. In view of the fact that the child takes a good-sized feed at regular intervals without vomiting, has its bowels open regularly, and its general condition is good, this is not taken as cause for disquiet. It is felt that further experimenting should find a solution which will cause it to gain weight more rapidly.

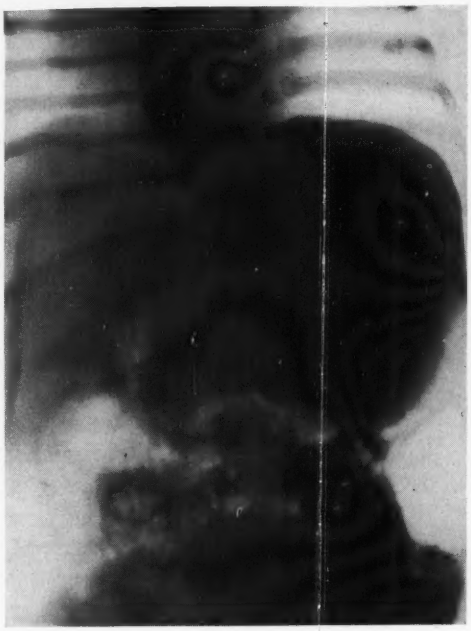

FIG. 216.—One month after operation. Radiograph 10 minutes after a meal. The stomach is full of barium and the œsophagus still shows dilatation.

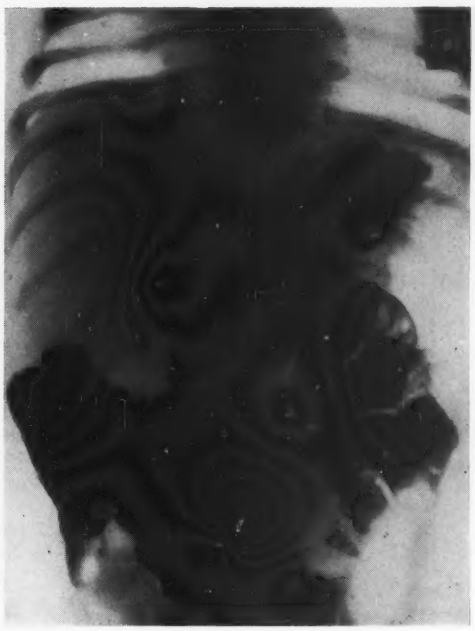

FIG. 217.—One hour after the previous picture. The stomach is seen to be practically empty and the gastro-enterostomy working well.

SUMMARY

1. A review is given of the literature of duodenal atresia and the condition is described. The atresia is extrinsic or intrinsic and may be complete, subtotal, or partial.

2. The condition is rare, but occurs more often than is generally supposed.

3. Gastro-enterostomy or duodenojejunostomy in the first few days of life provides the only hope of recovery in complete or subtotal atresia.

4. The literature reveals a large number of reported cases, but with very few successes by operation. Earlier diagnosis and surgical intervention should raise the percentage of these successes.

5. A case of a successful gastro-enterostomy on a four-day old child is reported.

I should like to express my gratitude to those who have contributed to the success of this case: to Dr. Quayle who had the unenviable task of administering the anæsthetic; to Dr. Collins for helpful advice in the post-operative feeding of the infant; and to Mr. Hayson, my House Surgeon, for his unremitting care of the case. A particular tribute must be paid to Sister Woollends and her nursing staff,

to whom must go a great deal of the credit for the child's survival. Finally, I am indebted to Mr. Ivor Lewis, Medical Superintendent of the North Middlesex Hospital, for permission to publish this case.

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ANAPHYLACTOID PURPURA SIMULATING ACUTE REGIONAL ILEITIS

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It is generally recognized that the anaphylactoid purpuras may produce severe symptoms referable to the joints and alimentary tract, in addition to the urticarial and purpuric skin rashes which characterize them. Although these purpuras are usually divided into Schönlein's disease when the main brunt of the attack falls upon the tissues around the joints, and Henoch's purpura when the sero-hæmorrhagic effusions occur principally into the walls of the bowel, there is no essential difference between the two, and often they occur together in the same patient. It is perhaps more common for Henoch's purpura to be met with in small children, and Schönlein's disease in older patients, but both are accompanied by purpura and urticaria due to increased permeability of the capillary walls, whilst usually the bleeding and clotting times of the blood are normal, and thrombocytopenia absent.

The case history which we report is of interest because it shows how difficult diagnosis may be when the visceral manifestations precede those in the skin; the patient showed visceral, skin, and joint manifestations in this order. An opportunity arose for examining the affected part of the bowel both during the acute phase of the attack and nine days later, and its superficial resemblance to regional ileitis is emphasized.

CASE REPORT

History.—The patient, F. B., was a man aged 30 years, an electrical fitter. He was admitted to hospital on Oct. 23, 1940, with a history of severe colicky pain which had started three days previously in the right iliac fossa, radiating down the backs of both thighs. The pain was now referred to the midline in the epigastrium. There had been no vomiting or urinary symptoms and the bowels were constipated. Neither the patient nor his relatives had ever suffered from any allergic manifestation such as asthma, urticaria, hay fever, or migraine, and his present illness had not been preceded by tonsillitis or other infection. He had always eaten normal amounts of fresh fruit and vegetables.

On Examination.—The patient's general condition was good. Temperature 99·2°, pulse 72, and respirations 20. The cardiovascular, respiratory, and nervous systems were normal, and no petechiæ or urticarial rash were present on the skin. The tongue was furred; teeth and gums normal. There was generalized guarding of the abdominal wall, but no true rigidity was present. At this time tenderness was maximal in the epigastrium. No mass was felt, nor were there signs of free fluid in the peritoneal cavity. Rectal examination revealed tenderness high up on the right side; there was no blood on the examining finger. The urine contained albumin, and chemical tests for blood were feebly positive.

A diagnosis of subacute appendicitis was made, the appendix being in the retrocæcal position in relation to the right ureter. The patient was admitted to a surgical ward, and it was decided to carry out conservative treatment, using the Ochsner-Sherren régime.

Progress.—During the next six days the temperature continued to swing, reaching 101° on two evenings, the pulse-rate rising proportionately. The bowels were opened on the day after admission, but no blood was seen in the fæces either then or at any time.

More detailed urinalysis showed a few red and white blood-cells in the centrifugalized deposit, but casts and organisms were not present.

The blood-count showed no anæmia, but there were 12,000 leucocytes per c.mm. with 73 per cent neutrophil polymorphs and 1 per cent eosinophils. The platelets were reported as " normal ", although a count was not done at this time. Agglutination tests against the enteric and salmonella groups were negative.

On Oct. 27, 1940, the patient experienced another acute attack of colicky pain in the umbilical region. The pain was not referred to the legs, back, or shoulders, and there was no vomiting or abdominal rigidity.

On Oct. 29, 1940, two red raised areas, each about 2 in. by 1 in. appeared on the dorsum of the hands. They did not itch, but were hot and painful, and faded without sharp demarcation into the surrounding skin. A blood-culture on this day grew no organisms. The leucocyte count had risen to 16,000 per c.mm.

On Nov. 1, 1940, an extremely severe attack of acute abdominal colic occurred, and it was decided to perform a laparotomy.

A right paramedian incision was made under gas–oxygen–ether anæsthesia. There was a moderate amount of blood-stained fluid in the peritoneal cavity. Much of the small intestine was seen to be collapsed, and was in striking contrast to the last two feet of the ileum, which was greatly congested, thickened, and œdematous. Many subperitoneal hæmorrhages were present in this area, and the appearance and feel of the affected bowel suggested that the underlying pathology was that of acute regional ileitis. The mesenteric glands were not enlarged. The colon and appendix were normal, and the spleen was not enlarged.

On the following day the patient's condition was improved and his abdominal pain was less. Examination now revealed very marked dermatographia all over the body, but the œdematous areas on the dorsum of the hands had disappeared. Hess's test was positive, 32 petechiæ being counted in an area covered by half a crown in the ante-cubital fossa after a sphygmomanometer cuff had been left on the arm for five minutes inflated to a point midway between systolic and diastolic blood-pressures. The bleeding time of the blood was three minutes and the clotting time eleven minutes—both within normal limits for the methods used. The thrombocyte count was 280,000 per c.mm.

Following the laparotomy the patient developed acute bronchitis and nine days later his wound broke down completely as a result of coughing and required to be re-sutured. The opportunity was taken to examine the ileum again—there were no petechiæ and the œdema of the terminal segment had disappeared ; in fact the ileum appeared normal in every respect.

On Nov. 22, 1940, when dermatographia was still present, skin tests were carried out, but revealed no hypersensitivity to the common antigens of food, pollens, feathers, dandruff, etc. The following day the patient complained of acute pains in both shoulders, especially on attempting to raise the arms. Examination revealed no abnormality beyond tenderness on deep pressure over the deltoid muscles, and the temperature was normal. It was assumed that the pains were another manifestation of the patient's allergic state. He was treated with vitamin P, ephedrine, and intramuscular injections of adrenaline in oil, and with these measures his symptoms rapidly recovered. He was discharged entirely free from symptoms on Dec. 12, 1940, and has kept well ever since.

DISCUSSION

The interest of the case lies in the fact that the abdominal symptoms preceded and completely overshadowed other allergic manifestations. The inflamed areas on the hands were mistaken for pyæmic abscesses, but as they rapidly disappeared without pus formation they were undoubtedly of urticarial origin, and should have led to the correct diagnosis.

The indefinite history of abdominal colic in association with the findings at laparotomy resemble those usually described in published cases of the acute form of regional ileitis. It is this type of the disease also which may resolve spontaneously, and of which little is known of the pathology as the affected segment of the bowel

is seldom removed. It occurs to us that some of these cases may in fact have been examples of anaphylactoid purpura. Unfortunately the reports are seldom in sufficient detail to enable one to decide whether any generalized vascular disorder may have been present. Mailer (1938), however, recorded in some detail a case which in its clinical aspects and operative findings appeared typical of acute regional ileitis, yet five days after laparotomy the patient developed petechial hæmorrhages and localized œdema of the dorsum of the left foot.

We suggest that the simple tests for dermatographia and capillary permeability might be carried out on any patient with obscure abdominal colic. Should these tests be positive the therapeutic effect of an intramuscular injection of adrenaline might be tried before exploratory laparotomy is performed.

SUMMARY

1. A case of anaphylactoid purpura is described in which alimentary symptoms preceded manifestations in the skin and joints.

2. The findings at operation were remarkably similar to those of acute regional ileitis.

3. Simple tests are described which may help to distinguish between these two conditions.

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SPONTANEOUS RENO-INGUINAL FISTULA IN CALCULOUS TUBERCULOUS PYONEPHROSIS

By H. S. SHUCKSMITH, T/Major, R.A.M.C.

Spontaneous renal fistula is a very uncommon condition. Cases are recorded of spontaneous fistulæ presenting on the surface of the lumbar triangle, penetrating through the diaphragm to the pleura or through the lung to the trachea, tracking along the psoas to present below the inguinal ligament, and probably most commonly of all into the colon (Wildbletz[1]).

Six cases of spontaneous reno-inguinal fistulæ have been reported since 1930, and these have occurred in renal tuberculosis or in neglected cases of renal calculi (Schindler[2]).

The coexistence of renal tuberculosis and renal calculi is rare. Tatnal[3] records that in the available literature 37 cases have been reported. The incidence of calculi in tuberculosis of the kidney is given by various authorities quoted by Wershunt[4] as 0·9–2·7 per cent—the average being 1·4 per cent. This author, in describing 6 cases of coexistent renal tuberculosis and calculus occurring in the service of the Sea View Sanatorium, carefully reviews the various factors which are thought to play a part in the genesis of stone. He points out that Randall considers that in every case of stone, infection is the prime cause. The marked infrequency of calculi in the tuberculous kidney is a convincing argument against infection being an important part in the aetiology of stone. Despite the local changes in the kidney which in other conditions are considered to set up stone formation and the general changes in metabolism which occur in renal tuberculosis, Wershunt[4] considers that the tuberculous patient has less liability to stone formation. This author has not even found increased incidence of stone formation in cases immobilized for tuberculosis of bone. Tatnall,[3] in his review of the 37 published cases, considers that in some tuberculosis preceded, and in others followed, the formation of calculi.

The case which is described here presented itself with an inguinal fistula. Pathological examination of the kidney showed the presence of tuberculosis in addition to calculous pyonephrosis. The upper part of the fistula was tuberculous, while through the lower part a calix-shaped calculus discharged several days after nephrectomy.

CASE REPORT

Private A, aged 22, was examined by a Medical Board before admission to the Army in July, 1939. He was graded A1. He carried out the normal infantry training.

In the early part of November, 1940, he complained of pain in the front of the left thigh. A slight limp developed a few days afterwards and a swelling was noticed immediately below the left inguinal ligament. This swelling was incised by the unit Medical Officer and a fistula persisted.

He was admitted to hospital on Jan. 8, 1941. There was a little discharge from the fistula, the margins of which were undermined and bluish. The horizontal chain of inguinal glands was enlarged, there was a little fullness in the left lower quadrant of the abdomen, and a grossly enlarged left kidney was palpable. There was slight scoliosis concave towards the left side, but flexion and extension of the spine were apparently normal.

The urine was acid and contained numerous pus cells, but was sterile on culture.

On X-ray examination multiple calculi were seen in the left kidney, many of which were calix-shaped (*Figs.* 218, 219). Radiographs of the chest and spine were normal.

FIG. 218.—Intravenous pyelogram. Right pelvis normal. No secretion on the left side. Multiple calculi on the left side. The opacities over the left ilium are due to iodoform which has been injected into the sinus.

FIG. 219.—Latera view showing multiple renal calculi.

Lipiodol injected into the fistula in the left inguinal region showed on radiography an irregular track extending behind the kidney as far as the level of the 2nd lumbar vertebra (*Figs.* 220–222).

Normal excretion from the right kidney was demonstrated by intravenous pyelography, but there was no evidence of excretion from the left kidney.

Cystoscopy revealed a bladder of normal capacity, mild trigonal congestion, and patchy phosphatic deposits on the mucous membrane. The right ureteric orifice was normal, while the left was relatively flat and did not contract. A full jet of indigocarmine was excreted from the right ureteric orifice six minutes after intravenous injection; there was no excretion from the left side. A ureteric catheter passed easily to the region of the pelvis of the left kidney. The injection of sodium bromide into the catheter caused no pain, although 60 c.c. were used; the explanation is seen in *Fig.* 222, where it shows that the bromide ran back into the bladder. Flattening of the left side of the dome of the bladder is evident in the cystogram so produced.

The blood-urea was 32 mg. per 100 mils. Although the patient was pale, the red cells numbered 5,900,000 per cm., with a hæmoglobin of 85 per cent; the white cells were 15,500 per cm., with a slight polymorphonucleocytosis.

Left nephrectomy was carried out on Jan. 14. A very large kidney embedded in much perinephritic tissue was freed easily except for a dense adhesion from the lower part of the kidney to the fistula at the level of the iliac crest. This finger-like adhesion had to be divided with scissors. The fistula was laid open and it extended as a smooth track from the level of the 2nd lumbar vertebra under the quadratus lumborum fascia to the level of the iliac crest

and then under the iliacus fascia to the thigh as a rough granulation track. Its attachment to the lower pole of the kidney was at the junction of the smooth and obviously granulating portions (*Fig.* 223).

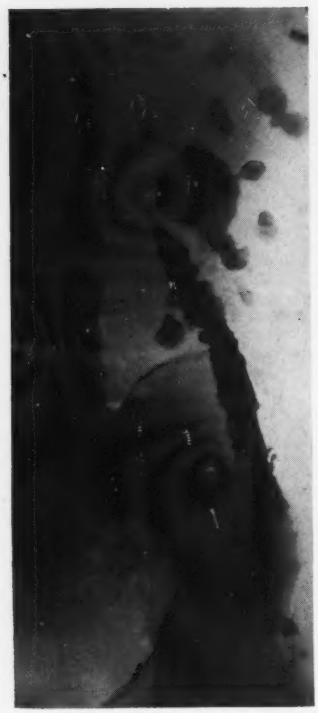

Fig. 220.

Fig. 221.

Fig. 222.

FIG. 220.—The sinus has been injected with lipiodol and its upper extremity extends to the middle of the calculi. The psoas outline is fairly distinct.

FIG. 221.—Lateral view of the sinus injected with lipiodol showing the upper extremity at the level of the 2nd lumbar transverse process.

FIG. 222.—Sodium bromide injected up a ureteric catheter ran back into the bladder. The upper extremity of the sinus appears to be near to the pelvis of the kidney. The opacity showing on the 3rd right lumbar transverse process is an artefact.

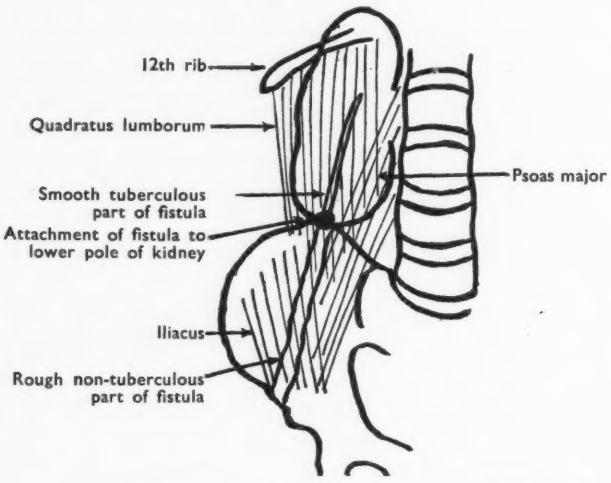

FIG. 223.—Diagram showing the course of the fistula.

Convalescence was uneventful. The wound and fistula healed well. A calculus was extruded fifteen days after operation from the inguinal fistula, which had been drained with a long tube.

PATHOLOGICAL REPORT.—The specimen measured 6 × 4 × 3 in. On section it was found to be converted into a series of loculi communicating with a considerably enlarged pelvis, the loculi ranging in size from ¾ in. to 1½ in. in diameter. The dilated pelvis, which was thick walled and had some inflammatory material lining it, contained a large somewhat triangular calculus measuring 1¾ × 1½ × 1 in. The dilated calices contained at least ten small calculi which were very irregular in shape, measuring from ½ to 1¼ in. in diameter; one or two of these were branching and fitted the contour of the calix. Towards one pole of the specimen where the renal parenchyma was better preserved, there were caseous foci resembling tubercles with calcification in the midst of them. The interior of the dilated calices presented a curious granular appearance as though they also were tuberculous.

Histologically two of the dilated calices examined microscopically were lined with a broad zone of granulated tissue, the superficial part of which had the characters of tuberculous granulation tissue although the deeper layers had no specific characters except for the presence of an occasional small tubercle follicle. In places the epithelial lining still survived.

Histology of the smooth-walled part of the fistula revealed definite tubercles, while the granulation tissue from the middle and lower parts of the fistula showed no evidence of tuberculosis.

COMMENTARY

This case presents a picture of an almost spontaneous reno-inguinal fistula which resulted from a kidney destroyed by calculi and tuberculosis. Beyond its clinical interest, the case adds a pathological problem in the consideration of whether calculus or tuberculosis be the primary lesion. Professor M. J. Stewart, to whom I am indebted for the pathological report, found that the caseous lesion at the lower pole of the kidney was of very long standing, but he believes that the calculi preceded the tuberculosis.

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A CASE OF ADENOMA OF THE EPIDIDYMIS WITH A NOTE ON SOLID TUMOURS OF THE EPIDIDYMIS

By GORDON GORDON-TAYLOR, Temp. Surgeon Rear-Admiral, and C. OMMANEY-DAVIS, Lt.-Commander, R.N.

Tumours of the epididymis are amongst the least frequent of all neoplasms; benign tumours of this structure are reckoned as constituting about one-third of the number of solid tumours of the epididymis recorded up to the present date (Scalfi[1]). The relatively large percentage of benign solid new growths amongst neoplasms of the epididymis is in fortunate contrast to the meagre proportion of testicular tumours of innocent character. Of benign tumours of this posterior appendage of the male organ of generation *lipoma* and *adenoma* vie with each other in their claim to unique incidence; we can find no record of any case of adenoma of the epididymis in the literature, although we are informed that another specimen has come under the observation of the Panel of Pathologists appointed by the British Empire Cancer Campaign. The rarity of the condition is our excuse for the publication of this individual case, which has an academic rather than a practical interest for the operating surgeon. The one case of lipoma of the epididymis recorded in the literature is that of Wildbolz,[2] of Berne, which presented itself as a small nodular painless swelling of the epididymis; there was an absence of any history of venereal infection; the tumour was conservatively removed by an epididymectomy. The development of a lipoma of the epididymis is remarkable, inasmuch as the epididymis normally contains no fat, although a little may be found in the connective-tissue coverings. In Wildbolz's case, however, the tumour is definitely stated to have originated within the containing coverings.

Leiomyoma constitutes a relatively frequent variety of the rare group of benign growths of the epididymis. The tumours are said to vary in size from a walnut to a mandarin orange. On two occasions the patient has presented a bilateral leiomyoma (Milner and Gilbert,[3] and Foged[4]).

A *fibromyoma* of the epididymis has been reported by Eisenstaedt,[5] who also recorded a swelling of the epididymis which, however, proved to be a granulomatous mass occurring as a foreign-body reaction to a quantity of paraffin which had been previously injected into the tissues of the cord for some unknown reason. The reader is left to speculate whether this was the aftermath of some beauty-treatment akin to the paraffin injections for nasal and facial deformities, or the unattractive breast, which was a popular method of treatment some years ago. Personal vanity and its cult are apparently not the prerogative of the female sex.

Pericanalicular fibroma has been recorded by Backer-Grendahl,[6] and a *dermoid cyst* by E. A. Votta.[7]

Angioma of the epididymis has been recorded by two British observers. A. L. d'Abreu's case,[8] of cavernous angioma, gave a history of six weeks; there was no history of injury, and the patient woke with a sensation of pain in the scrotum and

discovered a lump. One point of interest was the existence of blood-clot in the tunica vaginalis, a clinical phenomenon more suggestive of a malignant neoplasm.

J. P. Hosford's case[9] of epididymal angioma occurred in a youth of 15 years who complained of rapid enlargement of the testicle following a blow. This proved to be a cavernous angioma.

Lymphangioma appears to constitute about 27 per cent of all benign tumours of the epididymis. It is a benign congenital tumour, which does not recur after complete removal, and does not undergo malignant degeneration or metastasize. Pain from the pressure of the growing tumour on the neighbouring structures and the development of a hydrocele are the only clinical features.

A tumour of the epididymis has recently been reported by Béla Halpert,[10] which was removed from a negro of 60 years and which exhibited the histological characters of *both a lymphangioma and a leiomyoma.*

CASE REPORT

A. W., a naval rating, was admitted to hospital for a painless enlargement of the left testicle. The history amounted to only a few weeks; his attention was first attracted to the swelling of the left side of his scrotum, which occasioned a sense of heaviness. There was no history of venereal disease, and examination merely revealed a painless enlargement of the testicle. There was no hydrocele, no thickening of the cord, and no enlargement of prostate or vesiculæ seminales; testicular sensation was present. The epididymis was not

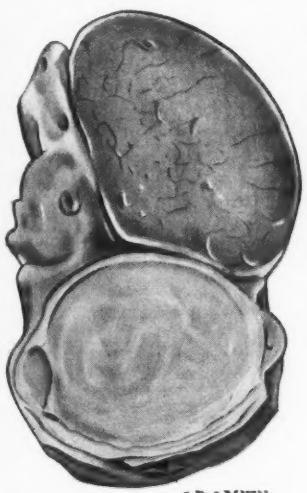

FIG. 224.—Drawing of the specimen.

FIG. 225.—Microphotograph showing a portion of the epididymis, the convolutions of its tubular structure being lined by high columnar epithelium. Alongside this are portions of the tumour, which consists of a mass of tubules with much smaller lumina than those of the tissue of origin. (× 40.)

seemingly selectively involved, and the tentative diagnosis of a tumour of the testicle was formulated and an exploration advised.

At the operation performed by one of us (C. Ommaney-Davis) the diagnosis of a new growth of the organ was confirmed, and a castration was carried out. The post-operative course was uneventful.

The specimen on examination revealed an encapsuled rounded tumour clearly demarcated by a definite capsule from the testicle proper, and apparently related to the lower pole of the epididymis (*Fig.* 224).

The microscopical report from the Bland-Sutton Institute, Middlesex Hospital, is as follows: Bland-Sutton Institute No. P.S. 65/40 (*Fig.* 225). The microphotograph (magnification × 40) shows a portion of the epididymis, the convolutions of its tubular structure being

lined by high columnar epithelium. Alongside this normal epididymal structure are portions of the tumour, which consists of a mass of tubules with much smaller lumina than those of the tissue of origin.

Comment.—It is idle to speculate upon the origin of the tumour; probably some aberrant cells in connexion with the mesonephric duct became sequestrated during embryonic life, and lying dormant for years subsequently took on active growth to form a tumour.

The interest in this case lies in the pathological picture of the tumour. For its identification we are greatly indebted to Dr. R. W. Scarff, of the Bland-Sutton Institute, Middlesex Hospital, and to his colleagues on the Pathological Panel of the British Empire Cancer Campaign.

To Dr. C. P. Smith, also of the Bland-Sutton Institute, we labour under a debt of gratitude for the illustration which accompanies the paper and for the micro-photographs which demonstrate its pathological histology.

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ADENOMA OF THE EPIDIDYMIS

By C. E. M. BLUMER
HONORARY SURGEON TO THE STAFFORDSHIRE GENERAL INFIRMARY
AND J. L. EDWARDS
PATHOLOGIST TO THE STAFFORDSHIRE COUNTY COUNCIL

THE following case is deemed worthy of record because the condition described is rare. Two references only have been found in the literature. The tumour recorded by Thompson[1] was a cystadenoma; that of Sakaguchi[2] was described as an " adenomyoma ". The detailed account, furnished with three illustrations, of this latter shows that the glandular tissue was interspersed by columns of plain muscle. The present tumour is not cystic and shows no plain muscle in sections stained by Van Gieson's method, except in the capsule, at the edge of the epididymis proper. In certain respects, therefore, the present tumour differs from that of Thompson and that of Sakaguchi.

CASE REPORT

CLINICAL DETAILS.—The patient was a big strapping man of good physique, aged 54. He had been married for about twenty years. He had three children. He was first seen in September, 1940, complaining of a hydrocele which had been present for about a year with no pain or disability of any kind. The hydrocele was tapped. At this time he stated he had a " stone " in the scrotum which he had had since he was a boy in his early teens. It had never bothered him in any way.

OPERATION.—An operation for radical cure of the hydrocele was performed in March, 1941. The parietal portion of the tunica vaginalis was clipped away and the cut margins sewn back over the epididymis. A small, round, hard mass was discovered at the lower pole of the testicle. The mass was removed by blunt dissection, and was completely and easily separated from the testis and epididymis, which appeared perfectly healthy. Recovery was uneventful.

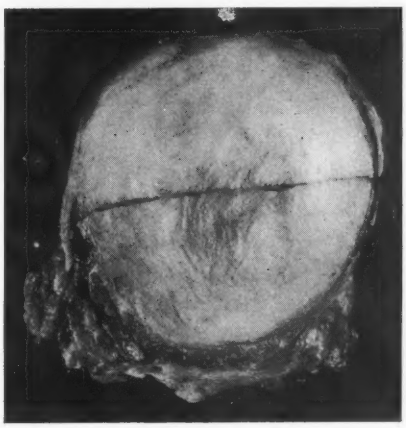

FIG. 226.—Cut surface of tumour. Bisected after fixation. Dark line is a scalpel cut. Part of epididymis below and to left.

THE SPECIMEN.—

Macroscopical Examination.—The specimen was a roughly spherical mass, 1¼ by 1½ in. in diameter (*Fig.* 226). The consistency was hard, but slightly elastic. Part of the tunica vaginalis was adherent. On bisection with the scalpel the cut surface presented a capsule, within which a firm structure, yellowish-white in colour with lighter bands (thus resembling a ' fibroid '), was seen. The mass was fixed in 10 per cent formol saline, embedded in paraffin, and sections were stained with hæmatoxylin and eosin and by Van Gieson's method.

Microscopical Examination (*Figs.* 227–229).—Part of the epididymis is seen in section immediately external to a fibrous capsule. The tissue within the capsule consists of numerous tubules separated by fibrous tissue and lined by a single layer of cells, cubical in some places, flattened in others. The tubules do not hold any visible contents such as blood, lymph, sperms, or secretion; but occasionally desquamated cells are seen in the lumina. The cells

are of epithelial type, and, when cubical or polyhedral, have clear, rather darkly stained, rounded, vesicular nuclei. The average size of the cubical cells is 10 μ diameter, but some cells are larger. When the cell is flattened the nucleus is distorted. No mitotic figures are seen. The cytoplasm stains pink with eosin. Granules are not obvious when viewed with the one-sixth objective, but fine, pink granules can be made out with the one-twelfth objective. One or two columns of cells without visible lumina are seen. These may represent dedifferentiation, but may be tubules cut tangentially. The variations between cells seem consistent

FIG. 227.—Edge of tumour, part of epididymis at right. (× 30.)

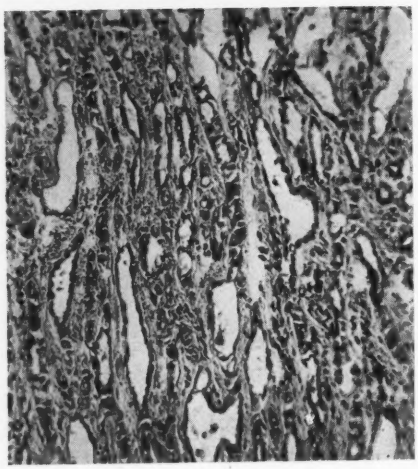

FIG. 228.—Typical tubules. (× 85.)

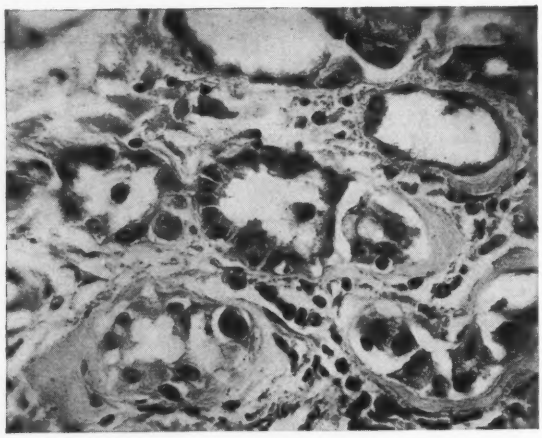

FIG. 229.—High-power view of tubules. (× 215.)

with pressure effects, and do not suggest malignancy to the writers. Lymphocytes in small numbers are scattered here and there in the fibrous tissue between the tubules and also in the capsule. Plain muscle is present in the outer layers of the capsule and in the adjacent portion of the epididymis, but none is seen in the stroma within the capsule. One or two well-formed blood-vessels are seen within the capsule.

DISCUSSION

The possible diagnoses in the present case would seem to be Wolffian remnant or part of the ductus aberrans, angioma, teratoma, endothelioma, adenoma, or carcinoma.

The presence of a capsule, and the appearance of the tubules, suggest a new formation rather than a vestigial structure. This statement in no way prejudices the possibility of adenoma arising from Wolffian remnants.

The cells lining the tubules closely resemble epithelium; no blood or lymph is seen in the lumina, although the firm capsule prevented collapse of the tubules on removal from the body, and although blood is seen in the capsular vessels. These points indicate that angioma is an improbable diagnosis.

No evidence of neoplastic elements derived from the three germinal layers, as in teratoma, is observed. The general appearance is consistent with an epithelial tumour; the presence of a capsule, the absence of mitoses and bizarre forms, indicate benignity; the long history (over thirty years), and ease of removal at operation, at least support that view. It is accordingly submitted that the diagnosis in this case should be adenoma.

That portion of the epididymis, but no part of the testis, is present in the outer part of the capsule is taken to indicate an origin from epididymis rather than from testis, cord, or tunica vaginalis. Furthermore, the glandular part of this tumour closely resembles the glandular part of the tumour described by Sakaguchi[2] as adenomyoma of the epididymis.

Histogenesis.—The possible origins of such tumours are discussed at some length by Sakaguchi.[2] We do not consider that we can throw any light on the matter.

Benign tumours of the epididymis are all rare. Thompson[1] in his review mentions the "adenomyoma" of Sakaguchi,[2] to which reference has already been made, and himself records a cystadenoma. Myoma is described as the most common benign tumour; fibroma, lympho-endothelioma, and angioma as rare; and lipoma as extremely rare. One dermoid cyst, and one benign cystic embryoma are described.

(Malignant tumours of the epididymis collected by Thompson[1] comprised 15 primary carcinomas, 1 seminoma, 10 sarcomas; teratoma is described as extremely rare.)

SUMMARY

A spherical tumour, about one and a half inches in diameter, which was removed at operation from the lower pole of the testicle, is described. Reasons for regarding it as an adenoma of the epididymis are adduced.

The photographs were made by Mr. D. Aitken, of Edinburgh, to whom we are greatly indebted.

We desire to thank Colonel W. F. Harvey and Professor M. J. Stewart for criticism and advice. In addition, one of us (J. L. E.) desires to thank Dr. W. D. Carruthers, Medical Officer of Health for the County of Stafford, for permission to publish this paper.

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A CASE OF ISLET ADENOMA OF THE PANCREAS

By THOMAS N. RUDD, Major, R.A.M.C.
and Sir JAMES WALTON, K.C.V.O., Colonel, A.M.S.

Although relatively rare, adenoma of the pancreas associated with hypoglycæmia has been recorded in a sufficient number of cases for the clinical syndrome to be well recognized, and for the value of operative treatment to be appreciated. In this short communication, therefore, no attempt will be made to summarize the literature. Those who are interested in this aspect will do well to study Whipple's masterly article.[1] In his monograph the clinical aspects of the subject are well reviewed, and our case is of interest in that it stresses this well-defined clinical picture and the rapidity with which the symptoms can be alleviated, and thus the diagnosis established, by the administration of glucose. In Whipple's article and in other published papers, attention has been directed to the fact that in many cases, although the symptoms seemed definite, no adenoma could be found at operation, in which case the consensus of opinion seems to be that the tail and body of the pancreas should be removed, partly in the belief that this portion of the gland is more likely to contain the adenoma, and partly in the hope that if the adenoma is left behind, the removal of this amount of the normal gland may be sufficient to control the hypoglycæmia. A search of the literature has failed to reveal to us any case in which the adenoma has been found unattached to the pancreas, and the fact that in our patient it was so situated, stresses the importance at the operation, of conducting a search around the pancreas, and this is perhaps the more emphasized in that in our case, the mass which ultimately proved to be the tumour was removed more in hope than in certainty.

CASE REPORT

L. W., a soldier aged 29, was admitted to a military hospital on March 30, 1941, at 10.30 a.m. The only history was that of four fits in the afternoon previous to admission, after which he had lapsed into stupor, from which he could just be roused. At 2.30 p.m. the ward medical officer called in one of us (T. N. R.) into consultation. The patient was then deeply unconscious, was flushed, and showed Cheyne-Stokes respirations. His pupils were moderately contracted, but reacted to light: the corneal reflexes were absent, the fundi were normal. All the limbs were rigid and extended, with a marked increase of extension tone and tendon reflexes. He was incontinent of urine and in a drenching sweat. His heart and lungs were normal; blood-pressure 120–70. The abdomen was relaxed and no tumour was palpable. There were two operation scars in the right iliac fossa and evidence of hernial repairs. The urine contained no albumin or sugar. A lumbar puncture gave cerebrospinal fluid under normal pressure, which on examination was found to contain 2 cells per c.mm., protein 50 mg. per cent, Wassermann and Lange negative.

A tentative diagnosis of post-epileptic coma was made. The possibility of a hypoglycæmic state was considered, but no insulin injection marks were seen. A blood-sugar estimation was, unfortunately, not carried out at this time.

At 7.30 p.m. the coma had deepened, and 50 c.c. of a 50 per cent solution of glucose were given intravenously. By the end of the administration, the patient showed a marked recovery and was able to talk sensibly. At 9.30 p.m. he began to relapse, his breathing

again became stertorous, with Cheyne-Stokes rhythm, and consciousness was again completely lost. A blood-sugar estimation at 10.30 p.m. showed a level of 0·048 gm. per cent. He was again given intravenous glucose with the same dramatic recovery.

At this stage, he was seen in consultation by us both. His wife, an exceptionally intelligent woman, had by this time arrived and supplied the following details of past history. She stated that two years and nine months ago he had had an attack of appendicitis with peritonitis. An operation was performed and the appendix removed. Some four months later he developed a strangulation of a right inguinal hernia, which was reduced by operation, but the hernia recurred and a radical cure by the Gallie method was performed two years ago. After these surgical adventures, he remained well until eight months ago. At that time, his wife went to wake him one morning as she thought he had over-slept, but she found him in a condition of stupor and mental confusion, with loss of memory. He was able to state, however, that " he thought he would soon be all right ". She brought him up a cup of tea and he rapidly recovered. When asked if the tea was sweet, she replied, " Oh, yes, he is a rare one for sugar and always has my ration ". She later took up his breakfast, but found he had fallen into it. She fed him and he soon recovered, and was able to get up. When the doctor called later in the day, the patient appeared to be well and was told that nothing could be found wrong with him. He stayed in bed for two days and then remained well until March 26. We made the diagnosis of spontaneous hypoglycæmia, probably due to an adenoma of the islet cells of the pancreas, which diagnosis was afterwards fully established.

Throughout the next twenty-four hours he was treated with intensive oral and rectal administration of glucose. He steadily improved, but his speech was difficult and he was rather confused for two or three days.

On March 31 a further lumbar puncture showed a normal cerebrospinal fluid of glucose content 0·068 per cent. It was, however, noted that from then until the time of his operation he appeared to be of slow and dull mentality. For the next ten days he was carefully investigated as regards his blood-sugar curves, his sugar tolerance, and his reactions to various diets.

From April 15 to April 18 inclusive he was maintained on a diet of 1990 calories, made up of carbohydrate 250 g., protein 90 g., fat 70 g. evenly distributed throughout the day, supplying 31 cals. per kg. body-weight, for the patient at rest in bed. Two blood-sugar estimations were made on each of two days, a late morning and mid-afternoon specimen being taken. The readings were :—

April 16 : 11.45 a.m., 0·156 per cent ; 3.45 p.m., 0·114 per cent
April 17 : 11.45 a.m., 0·060 per cent ; 3.45 p.m., 0·133 per cent
(Normal variation, 0·09–0·16 per cent)

He was now allowed up and his total calories increased to 2402 daily, this giving 38 calories per kilogram, the new distribution being carbohydrate 282 g., protein 112½ g., fat 91½ g., this quantity of carbohydrate being considered liberal. The following blood-sugar figures were then obtained :—

April 21 : 11.45 a.m., 0·04 per cent ; 3.20 p.m., 0·12 per cent
April 22 : 3.30 p.m., 0·015 per cent
April 23 : 11.30 a.m., 0·075 per cent ; 3.30 p.m., 0·150 per cent

The patient himself was fully satisfied with the diet. There was some tremor and unsteadiness when the two low values were recorded, but he volunteered no complaint, and consciousness was not disturbed.

A full blood glucose-tolerance test was carried out on April 28 :—

10 a.m. Fasting blood-sugar 0·07 per cent (normal fasting limits, 0·09–0·12 per cent)
50 g. glucose given

10.30 a.m.	0·11	per cent
11.00 a.m.	0·11	,, ,,
11.30 a.m.	0·133	,, ,,
12.00 noon	0·128	,, ,,
12.30 p.m.	0·12	,, ,,

The level of the blood-sugar was unpredictable and subject to considerable variation, without any marked apparent change in the clinical condition. The frequent low values

and the result of the tolerance curve which was comparable to some of Whipple's cases in which pancreatic adenomata were subsequently found, were an added incentive to operation.

On May 6 his condition was reviewed. He complained of general weakness and unsteadiness, and difficulty in gripping a knife and fork. On examination, his face was rather expressionless; he walked slowly on a broad base and with a slight general flexion; he was rather slow of speech and thought, and had difficulty in expressing ideas, his condition suggesting a Parkinsonian syndrome. Temperature and pulse were normal, weight 64 kg. Cranial nerves, optic discs, pyramidal systems, and sensations were all normal. There was a slight tremor of his hands. The abdomen was soft on palpation and no tumours could be felt. Other systems showed no abnormality.

The decision as to operation had now to be made. Although he could be kept fairly free from symptoms on a diet containing a liberal amount of carbohydrate, the instability of the blood-sugar suggested that he could not be regarded as free from danger. We considered that his cerebral condition was due either to the acute deprivation of the brain of glucose during his prolonged coma, or to recurrent subclinical attacks of hypoglycæmia. While we do not know of any other recorded case of Parkinson's syndrome being attributed to hypoglycæmia, it is at least a possible association, other agents which impair cerebral nutrition, such as coal-gas inhalation, being well-recognized causes of this condition. The patient and his relatives were naturally averse to yet another operation, as were we to recommend it, but the excessive lability of the blood-sugar with the possibility of progressive increase in the size of the adenoma indicated an ever-present risk of an acute recurrence of symptoms, with the added danger of further cerebral damage, from sugar deprivation, and operation was, therefore, strongly advised.

Operation (May 10, 1941).—Under general anæsthesia, a long incision was made transversely across the mid-epigastrium, both recti being divided. No abnormality was found in the gall-bladder or duodenum. The gastrocolic omentum was then ligatured and divided in the greater part of its length, a good view of the whole of the pancreas being thereby obtained. Nothing suggestive of an adenoma could be seen on the front of the pancreas, but it was thought that a rounded mass could be felt in the head of the gland. This was incised, but found to be normal pancreatic tissue, and the incision was sutured. A rounded swelling, almost certainly a lymphatic gland, was seen above the neck of the pancreas and removed. The second part of the duodenum was now mobilized and retracted inwards, but no tumour could be found in the outer side of the head. In the absence of any recognizable pathological lesion, it was decided to remove the tail and a portion of the body of the

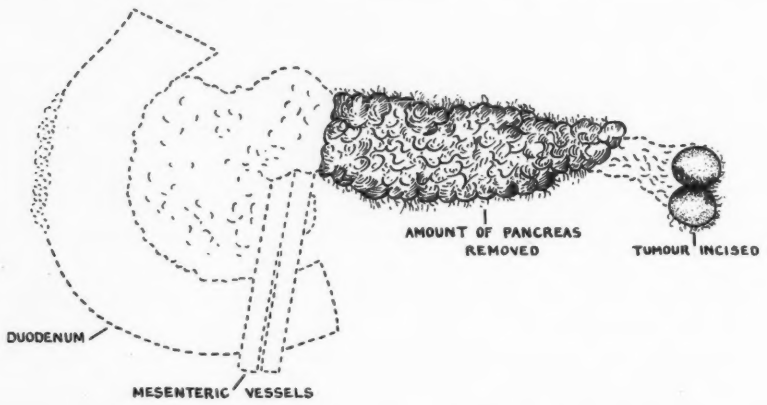

Fig. 230.—Diagram of cross-section of tumour and showing amount of pancreas removed.

apparently normal pancreas. The peritoneum was, therefore, incised and the body and tail freed in their upper and lower aspects. The only difficulty experienced was in the large number of small vessels passing from the splenic artery, all of which had to be tied. The tail was then freed and at this stage a small nodule could be felt in the lower part of the gastrosplenic omentum, about 1 in. beyond the lower part of the tail of the pancreas. It

was firm, rounded, and about half an inch in diameter. It was so embedded in omental fat that its colour could not be determined, but it was decided to remove it with the tail, in the hope that it might be the missing adenoma. The liberation of the body was continued, and when freed it was divided just distal to the neck, the superior mesenteric vessels being exposed and carefully avoided, the stump of the pancreas was sutured and embedded, the gastrohepatic omentum sutured, and the wound closed. (*Fig.* 230.) The patient showed very little disturbance.

THE SPECIMEN.—The portion removed consisted of the tail and the greater part of the body of the normal pancreas, in which there was nothing suggestive of an adenoma. The nodule beyond the tail was rounded, and on section showed a uniform, more-or-less granular pink surface. It did not show the outer and inner zones of a lymphatic gland, and the lobulation of the normal pancreatic tissue was absent. There was a definite space of nearly one inch between the tail and the nodule, which was composed of fatty omentum in which no pancreatic tissue was discernible.

On microscopical section, the tumour showed no definite capsule, but was surrounded by a varying amount of fibro-fatty tissue from which fine fibrous trabeculæ ran into the substance of the tumour, dividing it into numerous lobules (*Fig.* 231). In some of the trabeculæ, thick-walled vessels were seen. The periphery of the tumour consisted of many rounded and oval cells, interspersed with fibro-fatty tissue. These cells varied very considerably in size and depth of staining. Some of the larger were either multinucleate or showed mitoses. The bulk of the tumour consisted of cells resembling those of the pancreas, but, although collected in groups, there was no alveolar arrangement. They were generally cuboidal in shape, with rounded, well-staining nuclei and a zone of clear protoplasm. Owing to war conditions and the lack of specific material, it was not possible to demonstrate alpha and beta granules, nor to determine the presence of insulin, but there appeared to be no doubt that the tumour was an islet adenoma.

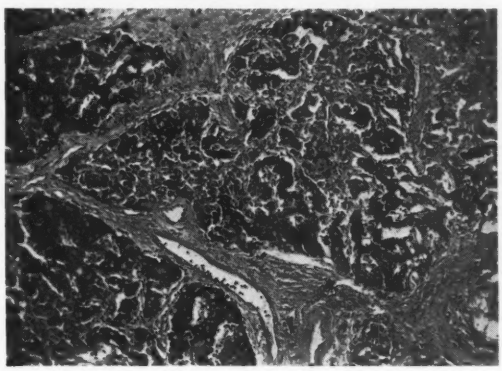

FIG. 231.—Microscopical section of tumour. (× 70.)

The rest of the pancreas did not show any abnormality and the islets were fairly well defined.

PROGRESS.—After operation, the patient made a quite uneventful convalescence. The stitches were removed on the tenth day, and he was allowed up on the twelfth. The most noticeable fact was the almost startling improvement in his mentality. After the third or fourth day, all his dullness and sluggishness disappeared, his speech became normal, and he spoke brightly and intelligently. His face recovered its expression, the tremor disappeared, and his limbs became stronger, so that at the end of ten days he was a bright, cheerful, and intelligent man. At no time did any sugar appear in his urine. Subsequent blood-sugar curves showed a restoration of normal tolerance, as the following figures show, the second readings being obtained on the date of his discharge from hospital (June 10):—

	10 *a.m. May* 22	*June* 10
Fasting blood-sugar	0·162 per cent	0·13 per cent
50 g. glucose given :—		
10.30 a.m.	0·19 ,, ,,	0·18 ,, ,,
11.00 a.m.	0·18 ,, ,,	0·17 ,, ,,
11.30 a.m.	0·17 ,, ,,	0·13 ,, ,,
12.00 noon	0·166 ,, ,,	—

He attended the medical clinic for the last time on July 3. His good progress had been maintained, he had had no disconcerting symptoms, and he stated that his old craving for sugar had disappeared.

COMMENT

These cases show in many ways a close resemblance to those of adenomata of the parathyroids. There is the same well-defined clinical picture, and the biochemical changes are so definite, and can so well be recognized, that a diagnosis can be made with certainty and exactitude. It is true that in many reported examples, there has been a failure to find the adenoma, but this has also been true of cases of adenoma of the parathyroid. In the latter, however, increase of knowledge as to the abnormal positions the parathyroids may occupy is greatly diminishing the number of cases of overlooked tumour, and the biochemist is taking up the position that with the presence of the characteristic findings, a tumour must be present. It would seem that the problem of pancreatic adenomata is very similar. Although there are reported cases where the tumour has not been discovered even at post-mortem examination, it is probable that with the increase of anatomical knowledge, these will become rarer. It is of interest to note that, just as in the parathyroid cases, surgery is passing through a stage where under these conditions, removal of a portion of the normal gland or glands has been advocated with incomplete success. The practical importance of our case, therefore, lies in the fact that an adenoma was found remote from the pancreas. If it had been appreciated that it might occupy such a position, it might not have been necessary to remove the portion of normal pancreas. This procedure will probably give rise to no trouble, but the surgical removal of normal tissue is always to be deprecated. The lesson to be learnt is that, in cases presenting such a definite clinical and biochemical picture, an adenoma is probably *always* present. In any case a most careful search must be made for it, both in and remote from the pancreas. Accessory pancreases are known to occur, and a recognition of their more common positions may, in the future, aid in the search.

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PERSISTING VITELLINE REMNANTS

By C. SOMERVILLE-LARGE, Major, R.A.M.C.,
and D. EASTMAN-NAGLE, Major, R.A.M.C.

The importance of vitelline remnants as a cause of abdominal complications in the adult has been described by Buchanan and Wapshaw[1] recently. Although remnants of the vitelline duct in the form of Meckel's diverticulum are not very uncommon, remnants of the vitelline vascular system are most unusual. In the following case remnants of both the duct and of the vascular system were found.

CASE REPORT

History.—In September, 1940, a private soldier, aged 20 years, was admitted to the Military Hospital, Shaftesbury, Dorset, complaining of a discharge from his umbilicus associated with some irritation.

He stated that he had noticed redness and mild soreness of his umbilicus for a period of about eighteen months. There was a discharge which soiled his clothes, but which was not foul, had no smell, and was almost clear in appearance. This discharge would come profusely at times, while at others it almost appeared to dry up.

In every other way he stated that he was perfectly well and had been passed into the highest category when joining the army.

On being re-examined as to his fitness to proceed for service overseas the condition of his umbilicus was noticed and he was sent to hospital. It was thought that in a hot climate the condition might get worse and become very irritable.

During the past eighteen months he had received various forms of treatment without influencing the condition to any extent.

On Examination.—The umbilicus was red and there was sufficient œdema of the lips to close it across. When the lips were separated the base and sides were red and swollen. There was no sign of new growth. The redness extended to the abdominal wall in a small circle round the umbilicus, the skin beyond this circle being normal.

There was a persistent discharge coming up from the base of the umbilicus; this had not the appearance of pus, but was more serous in character.

Microscopic examination of the fluid showed:—

Polymorphs	35	per c.mm.
Lymphocytes	160	,, ,,
Epithelial cells	10	,, ,,
Red blood-cells	10	,, ,,

No organisms were seen, but culture yielded a few colonies of *Staph. albus*.

At Operation.—With the lips of the umbilicus sewn together the whole area was removed.

As soon as the abdomen was opened it was found that there was a sac of fluid, projecting into the abdominal cavity, directly underneath the centre of the navel and attached to it. From the side of this sac ran a round cord, about the size of a diary pencil, downwards and backwards into the abdomen. When this cord was traced to its termination it was found to be attached to the left side of the mesentery of the small intestine. The point of attachment was about 2½ in. from the gut and exactly opposite a Meckel's diverticulum of 2 in. in length. This diverticulum was situated about 3 ft. from the ileocæcal valve and was of the same diameter as the small gut. The cord was not attached to the diverticulum in any way, the latter being entirely free from any attachments. (*Fig.* 232.)

The umbilicus, the sac of fluid under it, and the cord down to its attachment to the mesentery were removed in one piece. There was no indication to interfere with the diverticulum.

SPECIMEN.—The specimen consisted of the umbilicus, the sac, from which it was separated by some fibro-fatty tissue, and the round hard cord attached to the side of the sac at one end. Most of the sac and the cord were covered with peritoneum. There was a very small fistula connecting the skin in the umbilicus to the sac. (*Fig.* 233.)

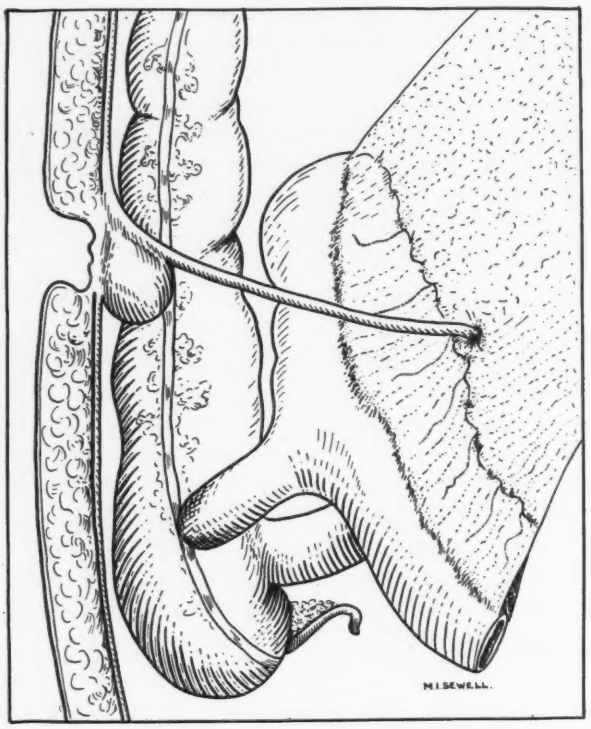

FIG. 232.—Drawing showing the sac of fluid projecting into the abdomen, and the cord running from it to a point in the mesentery of the small intestine opposite a Meckel's diverticulum.

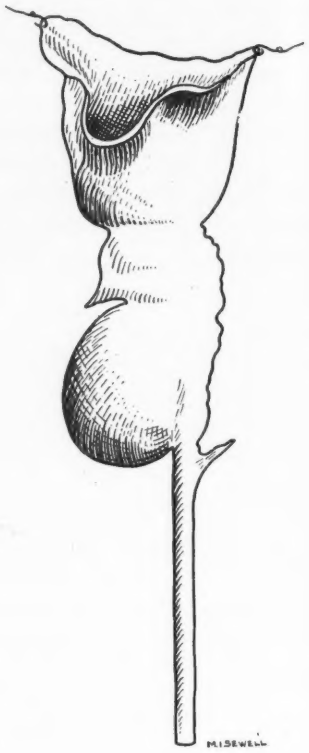

FIG. 233.—Drawing of the specimen.

Microscopical Examination.—Microscopical examination of the sac showed it to be composed of the following layers:

a. Peritoneum.

b. Fibro-fatty tissue.

c. Muscular layer: External fibres, longitudinal; Internal fibres, circular.

d. Muscularis mucosæ.

e. Mucosa: Rather narrow crypts going down almost to the muscularis mucosæ; columnar cells; there were racemose glands going through the muscularis mucosæ; no oxyntic cells were seen.

Microscopical examination of the cord showed that it consisted of the following structures:—

a. Large artery: Patent lumen with no blood-cells inside it; thickened interna coat; clearly defined elastic lamina.

b. One moderately large vein and several smaller ones.

c. Several nerve cords.

d. Stroma: Around the vessels this consisted of fibro-fatty tissue; more peripherally it consisted of denser fibrous tissue.

e. External peritoneal lining.

This specimen represents the remains of both the vitelline artery and vein, and also two parts of the intra-abdominal portion of the vitelline duct. The duct is represented proximally by a Meckel's diverticulum, average both in size and position, and distally by a secreting sac,

in construction similar to the small intestine, situated under the umbilicus and being entirely unconnected to the proximal end.

The vascular remnants are enclosed in a cord which lies free for its whole length in the abdomen, being only attached at each end—the proximal one to the left side of the mesentery where it originally formed the continuation of the superior mesenteric artery, and the distal end to the umbilicus and to the side of the sac. Whereas the distal end retained its embryonic relationship to the vitelline duct, the proximal end became entirely separated from it.

DISCUSSION

The interest in the case, therefore, lies not only in the vascular remnants as described, but also in the complete disappearance of the central part of the vitelline duct, leaving only a proximal part as a Meckel's diverticulum, and a distal part attached to the umbilicus as a small cyst, the size of a walnut, discharging through a small fistula on the skin of the umbilicus.

These structures normally undergo complete obliteration in the seventh week of fœtal life, while a Meckel's diverticulum is said to occur in about 2 per cent of all subjects. For a bibliography concerning the vitelline structures the article mentioned above should be consulted.

We wish to record our sincere thanks to Major Raper, R.A.M.C., for his help in the histology and in the preparation of the drawings, and to Colonel Skrimshire for permission to publish the paper.

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SHORT NOTES OF RARE OR OBSCURE CASES

AN UNUSUAL CASE OF LOOSE BODY IN THE ELBOW-JOINT

By N. VERE-HODGE

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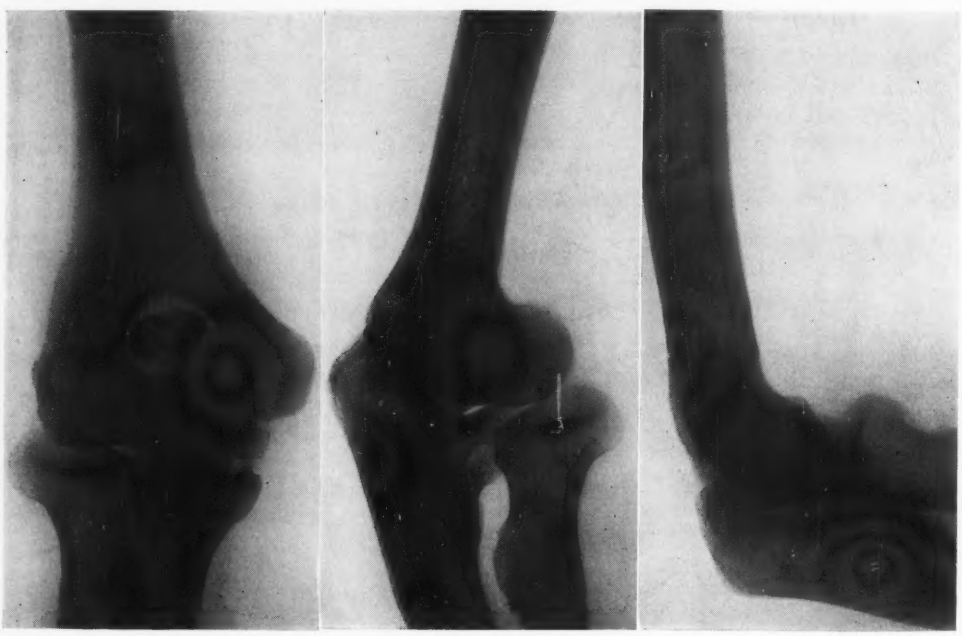
THE reason for reporting this case is the unusual mechanical process that has taken place in the elbow-joint since the formation of a loose body which has become deeply buried in the olecranon fossa of the humerus.

HISTORY.—R. B., male, aged 35 years, complained that for the last few months he had had occasional twinges of pain in the elbow with the sensation of something moving about in the joint and causing it to lock, so that he could not fully straighten the joint.

Twenty years ago, he had fractured both forearm bones on two separate occasions, but he thought the elbow-joint was not involved. In 1920 he also complained of aching and locking in this elbow, but radiographs taken at the Royal Infirmary, Liverpool, showed no abnormality, and after a course of physiotherapy, the elbow became apparently normal, subjectively and objectively.

ON EXAMINATION.—The elbow appeared normal. Active movements were 30° above and 85° below a right angle, with pronation and supination full. No locking or irregularity in rhythm could be elicited.



A B C

FIG. 234.—Radiographs of elbow-joint. A, Antero-posterior view; B, Oblique view; C, Lateral view.

Radiography (*Fig.* 234) showed a spherical cavity situated in the olecranon fossa of the humerus. This cavity had sclerotic walls, and the oblique view showed that the cavity was in continuity with the elbow-joint posteriorly. Within the cavity there was a loose body of discoid shape of varying radio-opacity. There was no evidence of the source of the loose body.

TREATMENT.—The loose body was removed by open operation. On opening the elbow-joint, there was found to be an excess of synovial fluid and the loose body was freely movable on all axes within the cavity. It was demonstrated that on full extension of the elbow, the tip of the olecranon process of the ulna could be made to impinge upon the loose body, moving it in its cavity. The walls of the cavity were quite smooth and eburnated. Nothing else abnormal was detected in the joint.

The post-operative recovery was not notable in any way.

THE SPECIMEN.—Photographs of the loose body are shown in *Fig.* 235.

Pathological section showed a core of hyaline cartilage covered with calcified material.

FIG. 235.—Photographs of the loose body removed at operation.

DISCUSSION

There was no indication, from the history, clinical findings, and radiographs, to suggest the exact origin of this loose body. The loose body was, presumably, formed many years ago, perhaps twenty years, when the patient sustained the fractures of his forearm.

The loose body having passed to the posterior compartment of the elbow-joint, and lying in the olecranon fossa, was struck by the olecranon process of the ulna every time the elbow-joint was fully extended, and by this mechanical force it was gradually embedded into the olecranon fossa. By the frequent repetition of this process the loose body was almost completely exteriorized from the joint.

It is also interesting that the patient apparently had no symptoms at the time when the loose body was lying free or only partly buried in the olecranon fossa, and that the symptoms arose at a stage when the loose body was almost completely exteriorized from the joint. The reason for the recent onset of symptoms may have been caused by a change of occupation to more heavy use of the elbow-joint.

I wish to thank Mr. R. Watson-Jones and Mr. Norman Roberts for allowing me to publish this case.

A CASE OF MULTIPLE ABDOMINAL LYMPHANGIOMATA

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ABDOMINAL lymphangiomata are uncommonly met, and of the diffuse type only three cases could be found in the literature.

CASE REPORT

HISTORY.—The patient was a woman of 47 years, with an incisional hernia following an operation for acute appendicitis four years ago.

Her case records showed that she had at that time complained of ingravescent abdominal pain for six weeks, and that at operation through the usual gridiron incision an acutely inflamed appendix was removed after separating many fibrinous adhesions. It was noted that the omentum contained "several small abscesses," but there is no mention of other abnormality not to be attributed to an ordinary case of appendicitis. The wound was drained and suppurated for three weeks.

On admission she was found to have an incisional hernia the size of a tangerine, but no other abnormality.

AT OPERATION.—The operation for repair of the hernia proceeded in the normal manner until the peritoneum was opened, when it was observed that a number of organs were studded with cysts, whereupon the peritoneum was more widely opened to obtain a better view.

A row of cysts was present along about 2 ft. of the ileum from the ileocæcal junction. They were thin-walled and transparent, filled with a clear, faintly yellowish fluid. For the most part they projected from the antimesenteric border, and varied from a spherical to an elongated sausage shape, and from 1 cm. to 3 cm. in diameter. The adjacent mesentery was apparently normal.

The great omentum was next examined, and was found to contain five or six similar cysts. A portion of omentum containing two of these was removed for microscopy.

There were a number of dense adhesions in the neighbourhood of the cæcum, and between it and the abdominal scar. When these had been separated, a large cyst about 4 cm. diameter was revealed behind the peritoneum of the posterior abdominal wall, in the angle between the cæcum and the attachment of the mesentery. Palpation of the pelvic organs revealed no abnormality. There was no evidence anywhere of any solid neoplastic tissue. As no surgical intervention appeared to be indicated, the peritoneum was closed, and the abdominal wall repaired with a fascia lata graft. The patient made an uninterrupted recovery.

THE SPECIMEN.—The pathologist's report on the omentum removed read as follows: "The specimen consisted of a portion of fatty omentum $4 \times 3 \times 0{\cdot}7$ cm. made up of thin-walled cysts, the largest of which was 1 cm. in diameter and contained clear watery fluid. The section shows that the cyst walls are lined by mesothelial cells and are formed by a fibromuscular connective-tissue base. The appearances would suggest a cavernous lymphangioma."

DISCUSSION

Lymphangiomata are usually classified as simple, cavernous, and cystic. Nearly all the abdominal lymphangiomata reported have been of the cystic type, although in one or two cases small islets of cavernous tissue have lain alongside single cysts.[1]

They may consist of either: (1) A single unilocular cyst (the most common); (2) A single multilocular cyst; (3) A polycystic form (the rarest). They may be found in various organs.

The commonest situation is the mesentery, where they constitute one form of mesenteric cyst. Roller[2] estimates that about 500 such cases have been reported. The next common situation is retroperitoneal.[1] A few cases have been reported of multiple cystic disease of the great omentum, resembling closely the condition found in that organ in this case.[3, 4, 5]. A diffuse cystic condition affecting several organs as described in this case appears to be very rare.[6, 7]

I am indebted to Mr. Elliot Smith for permission to publish this case, and to Dr. Robb-Smith for the pathological report.

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MECKEL'S DIVERTICULUM CAUSING OBSTRUCTION BY TYING A KNOT AROUND THE ADJACENT ILEUM IN A MAN OF 74 YEARS

By G. C. DORLING

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THE following case is recorded as it presented certain unusual features—namely, the advanced age, the rapid onset, and the complicated knot by which the diverticulum produced obstruction.

HISTORY.—Man, aged 74. No previous attacks. Admitted as perforated acute appendicitis, with 28 hours' history of generalized abdominal pain which had settled in the right iliac fossa. Vomited at the onset, during the day, and in the receiving ward.

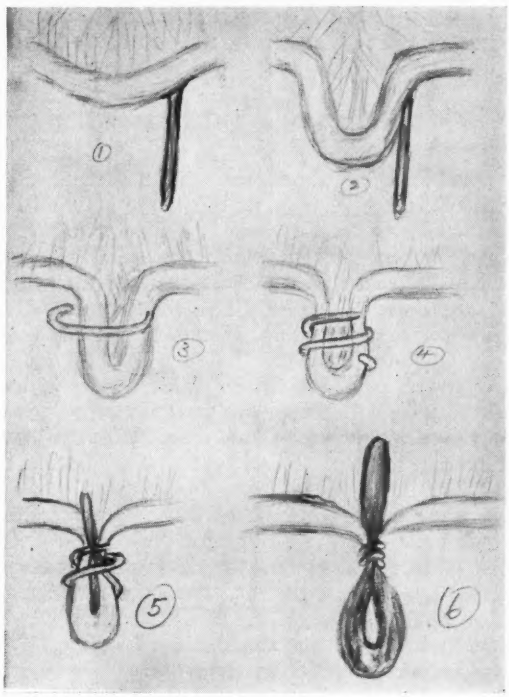

FIG. 236.—Showing the stages in the formation of the obstruction.

AT OPERATION.—On opening the abdomen a blackish-green Meckel's diverticulum presented itself. It had tied a double knot round the adjacent coil of small intestine, which was also gangrenous. This was resected and a side-to-side anastomosis performed.

The patient made an uninterrupted recovery and was discharged home on the eighteenth day.

I wish to thank Dr. L. Charney, who unravelled the specimen in the theatre and sketched the accompanying diagrams of the stages in the production of the knot. I also have to thank the Medical Superintendent of Lewisham Hospital and Dr. W. Allen Daley, of the London County Council, for permission to publish this case.

UNIQUE INTERNAL HERNIA

By JUDSON T. CHESTERMAN
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INTERNAL hernia, though rare, is a well-recognized condition. Hence I have not thought it worth recording three such cases of strangulation, one in the foramen of Winslow, and the other two through an opening at the lower part of the mesentery; though one of these latter cases was interesting in that there was a long history of both abdominal pain and megalocytic anæmia, and at operation several feet of ileum were found running down and to the left through the hiatus, while the pelvic colon passed in the reverse direction.

The following case, however, appears to be unique, and for this reason is recorded.

CASE REPORT

HISTORY.—A. H., male, aged 73, Case No. 140780, was admitted on March 5, 1941, complaining of abdominal pain. At 7.30 p.m. the night before he partook of a "hearty dinner" and felt he had "overeaten at the time". He went to bed at 12.30 a.m. and slept until 3 a.m., when he was awakened by intestinal colic which was most severe to the right of the umbilicus. At 5 a.m., to ease the pain, he took some tea with whisky in it, following which he vomited three times without relief. The colic continued and also the right side of the abdomen became increasingly tender. Nausea remained, but there was no further vomiting.

Previous history: Widower, twelve of fifteen children alive and well. Was a file-cutter from 1880 to 1914, when he joined the army, but was discharged 1916 for prolapsed hæmorrhoids which spontaneously cured themselves after his refusal to have an operation. This was the only previous illness in his life. From 1916 to 1940 he was a manual labourer, and retired at the age of 72.

ON ADMISSION.—He was a healthy old man. Pulse 54, respiration 20, temperature 97°. Tongue coated white, but breath was not offensive.

Abdomen: No obvious distension or mass seen; movement fair on respiration. Palpation showed marked tenderness in the right iliac fossa maximal one inch from the anterior superior iliac spine on the right spino-umbilical line. No mass was felt. Intestinal sounds were present on auscultation and were not abnormal.

Rectal examination: Indefinite tenderness high up.

Heart: Pulse slow, and first sound accentuated (later electrocardiograph showed L.V.P. and occasional ventricular extrasystoles).

Blood-pressure, 230/105.

Lungs: Nothing abnormal found.

Urine: A trace of albumin.

The pre-operative diagnosis was acute appendicitis in the lateral cæcal position.

OPERATION (15 hours after onset).—Anæsthetic, open ether. When anæsthetized, palpation suggested a mass of bowel fixed in the right iliac fossa. The abdomen was opened by a right paramedian incision running down from the level of the umbilicus for four and a half inches and the following was found: The cæcum and the lower half of the ascending colon were firmly fixed to the abdominal wall by Jackson's membrane, which was running from the region of the anterior tænia to the white line on the right postero-lateral aspect of the parietes. At the upper end was an orifice which admitted the tips of three fingers, while at the lower end the opening was barely a third of that size. Into the upper orifice four inches

of the lower ileum were strangulated. The bowel was viable after being freed by cutting the membrane at its junction with the anterior tænia. It was found that the upper limit of the membrane corresponded to the more firm attachment of the ascending colon to the posterior abdominal wall, for below that level there was a mesocolon, so forming quite a large pouch with upper and lower orifices as described. The abdomen was closed in layers.

Convalescence was uneventful and the patient was discharged, after celebrating his 74th birthday, symptomless.

I wish to thank Dr. J. Rennie, Medical Officer of Health, and Dr. J. Clark, Medical Superintendent, for permission to publish this case, and especially to acknowledge the courtesy of the Librarian of the Royal Society of Medicine for his unavailing efforts to trace any similar case.

REVIEWS AND NOTICES OF BOOKS

Surgery of Modern Warfare. Compiled by Sixty-five Contributors. Edited by HAMILTON BAILEY, F.R.C.S. (Eng.), Surgeon, Royal Northern Hospital, London; etc. Issued in five separate parts. $9\frac{3}{4} \times 6\frac{7}{8}$ in. Part V: Section IX, continued; Section X, Wounds of the Central Nervous System and its Coverings; Section XI, Surgical Diseases encountered in Subtropical Countries; Section XII, Administration; Section XIII, Appendix. Pp. 641–876. *Figs.* 684–828. 1941. Edinburgh: E. & S. Livingstone. 17s. 6d. net.

WITH the publication of Part V, this book is now completed. One can only endorse the opinion expressed when the earlier parts were published that this book is a credit to all concerned both in conception and accomplishment. The publishers and Editor have indeed cause for mutual congratulation.

Part V deals with wounds of the face, neck, and central nervous system. There is also an important section dealing with surgical diseases more or less peculiar to sub-tropical countries. The book is brought to a conclusion by a very full account of the important subject of administration in dealing with the wounded.

As a postscript the Editor has made a most concise and interesting epitome of researches and observations on war injuries which have been published since the outbreak of hostilities. These should be incorporated with the respective sections in subsequent editions. The Editor will no doubt be chary of accepting many of these opinions at their face value without being subjected to the test of experience. Even as the conditions and conclusions of modern warfare are always fluid and variable, so also must be the surgical treatment of the resulting injuries. Dogmatism is impossible in any kind of warfare.

The Editor apologizes for having himself written the article on wounds of the neck, as he was unable to get any surgeon of repute to undertake this section. His difficulty will be no less in subsequent editions. It would be hard to improve on this section.

The sections dealing with wounds of the central nervous system are excellent, and should be read and digested by all who are practising surgery, whatever may be their particular bent. As the author of "Injuries of the Brain and Skull" says, modern surgery "involves particular diagnosis, assessment and decision, operation when required, and management until maximum recovery is attained".

These articles are written as the result of such a viewpoint with a wealth of clinical experience to draw upon. The blending of the diagnostic acumen of the physician with the surgical technique and management of the surgeon is amply illustrated in the article on "War Injuries of the Spine and Cord".

It was an inspiration to follow these articles with one by a specialist on "The Management of the Bladder in Spinal Injuries". This will be a source of reference for surgeons for a long time, and the precepts laid down will be the means of relieving many from untold discomfort and the saving of life.

When the whole Empire is involved, any "Surgery of Modern Warfare" must deal with those surgical conditions peculiar to sub-tropical countries. Those called upon to deal with such conditions will be grateful for the section devoted to this subject.

It would have been more helpful, however, if the case quoted to illustrate the beneficial effects of cæcostomy and ileostomy in the treatment of bacillary dysentery had been followed up a little longer before going into such panegyrics. The year of the operation is not mentioned, so it is presumed that "the play" is spread over a period of seventeen weeks, the curtain being rung down when the terminal ileum was anastomosed to the transverse colon, the abdomen closed, followed by "an uneventful recovery". One cannot help wondering what has happened to the cul-de-sac consisting of the cæcum and ascending and proximal portions of the transverse colon, and what the future has in store for the patient. Subsequent editions may enlighten the reader.

"Administration" has always been the bugbear of the temporary surgeon, and it is a good thing that the section on this should have been dealt with so fully by experts. It is often difficult and even apparently impossible for the surgeon who has had his training in a well-equipped hospital to realize the work involved in evacuating and dealing with a large

number of wounded. At the same time there are cases being admitted and discharged; active treatment may be going on as well; in addition, the tactical situation is often changing all the time. The multitude of problems with which the administration has to deal can only be solved by strict discipline, attention to orders, and meticulous care in preparing short but adequate records which must accompany the patients. It is from the administrative and surgical point of view often much easier to clear up a prolonged 'blitz' than a short sharp one. It is for this reason that, as we are reminded in the postscript, many have been disappointed in the results obtained by resuscitation methods, etc., when dealing with the injured from a short sharp 'blitz'. No proper conclusion can be drawn from such cases alone; if the 'blitz' had been prolonged they might never have reached the resuscitation teams.

It can be safely predicted that this book will remain the standard for a long time to come and has filled a long-felt want in surgical literature.

Synopsis of the Principles of Surgery. By JACOB K. BERMAN, A.B., M.D., F.R.C.S., Assistant Professor of Surgery, Indiana University School of Medicine, Indianapolis. 8 × 5 in. Pp. 615, with 274 illustrations. 1940. London: Henry Kimpton. 25s. net.

THE author begins his preface "Science may be defined as systematized knowledge; since the practice of surgery defies exact formulation it must remain an art".

It is difficult to see how this state of things will ever be altered, nor will it be helped by making a synopsis of the principles upon which such science and art is founded. To talk of a synopsis of principles is almost a contradiction in terms.

The author has attempted a synopsis in 615 pages not merely of surgery but also of all the basic sciences on which it is founded. The pages are so crowded with little bits of knowledge certainly expressed in trite and pithy sentences that there is no possibility of "correlating the basic sciences", and rather than "inspire the student to search through the selected references for more complete information", it will, we venture to think, have the opposite effect.

The first chapter sums up the impression left on the mind after reading the book. In it the History of Surgery is dealt with in ten pages. It consists of a series of staccato paragraphs with no interwoven motif, e.g., "Leonardo da Vinci (1452–1519), the artist who painted the Mona Lisa, drew excellent anatomic charts".

The basis of surgical pathology, the subject of Chapter II, occupies eight pages, and so the various sections follow one another in breathless haste, accompanied by various charts and lists of possibilities and probabilities from the aetiological and symptomatic point of view, until the whole range of the "conquered ground" has been covered. There is no attempt made to encourage the student to consolidate this new territory. It is hard to see how such a book can in any way help the student to that peace of mind and assurance in his work with which the principles of his subject should endow him.

As a note-book for a lecturer called upon suddenly to take a class in a subject with which he is not very familiar, the book may have some utility.

It is certain that the compilation represents an enormous amount of work and abstracting. It is certainly a model of condensation, but too much has been attempted in too short a time and too small a space.

It is a book which will be of no help to the newly initiated student and may even be dangerous to those more advanced. The foot-notes, which are numerous, will be valuable to a lecturer.

The reading of it leaves the impression that it is a good thing to know that there will always be an art as well as a science of surgery.

The Treatment of Burns. (Oxford War Manuals—General Editor, The Rt. Hon. Lord HORDER.) By A. B. WALLACE, M.B., F.R.C.S. Ed., M.Sc. (McGill), Surgeon, Scottish Emergency Medical Service; Assistant, Department of Surgery, University of Edinburgh; Assistant Surgeon, Royal Hospital for Sick Children, Edinburgh; Assistant Surgeon, Municipal Hospitals, Edinburgh. 6⅝ × 4⅛ in. Pp. 113 + xiii, with 16 illustrations. 1941. London: Oxford University Press. 5s. net.

THIS is the second *Oxford War Manual* to be published and contains some useful information on the subject of burns. It deals for the most part with burns in children and the treatment given at the Royal Hospital for Sick Children at Edinburgh, and all the illustrations depict infants undergoing treatment for burns.

Quite a lot of space is taken up with a consideration of the extent of burns and the calculation of total surface area involved in burns, and various formulæ are given. Surely this is of little real value.

Very little is said about war burns, which is a pity, as the Royal Navy and Royal Air Force have had several hundred cases to treat since the war began. No mention whatever is made of the first-aid treatment adopted by the three fighting forces for the treatment of burns, which seems to be an omission of some moment.

The tannic-acid treatment of burns is well described, and, in detail, but the value of the various dyes is not stressed, nor advocated. Notwithstanding this, gentian violet 1 per cent is advised before either tannic acid or silver nitrate is applied. After reading this book one feels that the treatment of burns has become more complicated and not more simple during the last two years.

Technique of Gastric Operations. By RODNEY MAINGOT, F.R.C.S. (Eng.), Senior Surgeon to the Southend General Hospital and to the Royal Waterloo Hospital, London; etc. $8\frac{3}{4} \times 5\frac{1}{2}$ in. Pp. 240 + xii, with 55 illustrations. 1941. London: Oxford University Press. 15s. net.

THIS book is dedicated to sixty-two named medical students who were transferred from the London Hospital to the Southend General Hospital for part of their clinical training from September, 1939, to December, 1940.

It is to be hoped that each one is the proud possessor of a copy indicating thereby not merely the reciprocity of the author's friendship and esteem, but also that they share his orderliness of thought and care for minute detail in their daily work.

The book is one which should be welcomed by every surgeon interested in abdominal surgery in general, and the operative technique for the relief of gastroduodenal disease in particular. It covers the whole range of such technique and the author is to be congratulated upon the labours involved in epitomizing such a vast and controversial subject into so small a space. The tendency to be too dogmatic, which is so often characteristic of the short book, has been avoided, though the author indicates in no uncertain way those methods which he himself adopts and gives cogent reasons for avoiding others.

It is very useful to have such a book devoted to one subject, and the publishers might well pursue the idea with other similar monographs. The whole range of gastric surgery is covered, from the various methods of opening and closing the abdomen to the treatment of the complications which may result. Due stress is laid upon the pre- and post-operative treatment of these cases.

Throughout the book adequate medical treatment is fully insisted upon. The problem of the operative treatment of duodenal ulcer is less controversial if this has been done. Short-circuit operations are not sufficiently successful in the long run in those cases in which there is no pyloric stenosis, and subtotal gastrectomy is certainly the author's operation of choice for such a condition. Most surgeons will endorse this, while at the same time agreeing that gastro-jejunostomy also has a real place in the treatment when there is delayed emptying of the stomach.

It is to be regretted that more stress has not been laid upon the use of local and spinal anæsthesia in gastric surgery. The author recommends local anæsthesia for congenital pyloric stenosis and subtotal gastrectomy for cancer. In the case of gastrojejunal ulcer, where he rightly demands "radical surgery" as the only choice, he urges that spinal anæsthesia "has in my experience contributed largely to the safety and the smoothness of performance of radical gastrectomy". Surely a combination of spinal and local anæsthesia would be best for all gastric operations, except in the very nervous patient.

The author is inclined to regard gastric ulcer as a precursor of malignant disease more often than statistics justify, but on the other hand, as he says, the evidence of the healing of a gastric ulcer by radiography, biochemical tests, and gastroscopy should be irrefutable before surgical treatment is finally ruled out.

There is no class of properly selected case which justifies more the axiom that "early surgery is successful surgery", and with modern methods of diagnostic technique the early cancer should be diagnosed much earlier than at present. The best clinics can still only show at the best a 50 per cent operability in diagnosed cases.

It is not clear why tension sutures should be put through all the layers of the abdominal wall, nor what definite contra-indication there can be to advising operation for congenital pyloric stenosis "with a palpable lump".

The book can be strongly recommended, and the surgeons reading it may be surprised to find that they have evolved their own technique made up of various operations, and that any success they may achieve may be due more to knowing their own technique thoroughly rather than to practising one laid down by any particular authority.

The format and illustrations of the book are excellent.

Oral Surgery. By STERLING V. MEAD, D.D.S., M.S., Washington, D.C. Second edition. $9\frac{7}{8} \times 6\frac{3}{8}$ in. Pp. 1315, with 553 illustrations and 7 coloured plates. 1940. London: Henry Kimpton. 63s. net.

THIS is a large and very heavy book, suggesting by its size that the subject has been fully dealt with. It is divided into forty-seven chapters and there are 1286 pages of text. The paper is of heavy leaded type and there are 553 illustrations with 7 coloured plates. The reader would naturally expect to find an all-inclusive compendium, but an examination of the various sections does not fulfil that promise. If we judge the work by the more surgical subjects, the verdict must be one of disappointment. To take only a few examples, the section on cancrum oris is certainly not very helpful, and one must make the same criticism about the chapter on hæmorrhage. It is a little naïve of the author to write that elevation is one of the simplest methods of arresting hæmorrhage and to state that in cerebral hæmorrhage the head of the bed should be elevated. In a long list of astringents and styptics it is curious that no mention is made either of snake venom or turpentine. Necrosis of the jaw with all its possible complications and sequelæ is dealt with in half a page and there is practically no guidance as to its management.

The section on cleft palate is somewhat of a hotch-potch, with a great many abstracts from other works. The author is wise enough to give extensive verbatim quotations from Wardill's description of his own operative measures, but there is no word about the difficulties, complications, or the results to be expected.

This book is certainly disappointing from the surgical point of view. It is possible that the dental section is of a higher standard than the rest, but your reviewer feels that British surgeons will not obtain much help or encouragement from perusal of its pages.

BOOK NOTICES

[The Editorial Committee acknowledge with thanks the receipt of the following volumes. A selection will be made from these for review, precedence being given to new books and to those having the greatest interest for our readers.]

A Short Practice of Surgery. By HAMILTON BAILEY, F.R.C.S. (Eng.), Surgeon, Royal Northern Hospital, London; Surgeon and Urologist, Essex County Council, etc.; and R. J. MCNEILL LOVE, M.S. (Lond.), F.R.C.S. (Eng.), Surgeon, Royal Northern and Metropolitan Hospitals, etc. Fifth edition. $8\frac{1}{2} \times 5\frac{1}{2}$ in. Pp. 1015 + viii, with 880 illustrations, of which 116 are coloured. 1941. London: H. K. Lewis & Co. Ltd. 30s. net.

Training and Efficiency. An Experiment in Physical and Economic Rehabilitation. By E. JOKL, E. H. CLUVER, C. GOEDVOLK, and T. W. DE JONGH. $10\frac{1}{4} \times 7\frac{5}{8}$ in. Pp. 188 + viii, with 18 plates. 1941. Johannesburg: The South African Institute for Medical Research. Price not given.

Food and the War. A Report of an Enquiry into the Adequacy of the Incomes and Expenditures of One Hundred-and-Three Families on Low and Moderate Incomes, during the period April to November, 1940. $9\frac{1}{2} \times 6$ in. Pp. 28. 1941. Edinburgh: The Children's Nutrition Council (Edinburgh Branch). 3d. (12 copies, 2s. 6d.).

Surgical Nursing and After-Treatment. A Handbook for Nurses and others. By H. C. RUTHERFORD DARLING, M.D., M.S. (Lond.), F.R.C.S. (Eng.), F.R.F.P.S. (Glasgow), Surgeon, Prince Henry Hospital, and New South Wales Masonic Hospital, Sydney, N.S.W. Seventh edition. $7\frac{1}{8} \times 4\frac{3}{4}$ in. Pp. 726 + x, with 207 illustrations. 1941. London: J. & A. Churchill Ltd. 10s. 6d. net.

Surgical Diseases of the Spinal Cord, Membranes, and Nerve Roots. Symptoms, Diagnosis, and Treatment. By CHARLES A. ELSBERG, M.D., Emeritus Professor of Neurological Surgery, College of Physicians and Surgeons, Columbia University; etc. With Chapters by CORNELIUS G. DYKE, M.D., Associate Professor of Radiology, College of Physicians and Surgeons, Columbia University; etc.; and ABNER WOLF, M.D., Assistant Professor of Neuropathology, College of Physicians and Surgeons, Columbia University; etc. 10 × 7 in. Pp. 598 + viii, with 249 illustrations. 1941. New York: Paul B. Hoeber, Inc. $14.00.